# K.S. Rangasamy College of Technology

**(Autonomous Institution)**

# Curriculum & Syllabus

# of

# B.Tech. Biotechnology

# R 2010

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

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

## Vision

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

## Mission

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

## The Programme Educational Objectives of the department are:

I. Graduates are professionally competent in Biotechnology to solve problems in environmental, food, biochemical and biomedical engineering and technology.

II. Graduates demonstrate proficiency in theory and practice of biotechniques through life-long learning.

III. Graduates perform as an individual and / or member of a team with professional and ethical behaviour.

## Programme Outcome (POs) relevant to the programme are listed below:

a) Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems in Biotechnology.

b) Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.

c) Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate co nsideration for public health and safety, and cultural, societal, and environmental considerations.

d) Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.

f) Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering and technology practice.

g) Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and technology practice.

i) Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

| K.S. Rangasamy College of Technology, Tiruchengode - 637 215 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Curriculum for the Programmes under Autonomous Scheme | | | | | | | | |
| Regulation | R 2010 | | | | | | | |
| Department | Department of Biotechnology | | | | | | | |
| Programme Code & Name | BT : B.Tech Biotechnology | | | | | | | |
| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 EN 101 | Technical English | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 MA 101 | Engineering Mathematics I | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 PH 105 | Material Science for Bio-Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 CH 101 | Engineering Chemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 GE 102 | Engineering Graphics (BT, CS, EC, EE, EI, IT) | 2 | 0 | 3 | 4 | 50 | 50 | 100 |
| 10 GE 108 | Electrical Technology (BT, CE) | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 CH 100 | Engineering Chemistry Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 GE 1P1 | Engineering Practices Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| | Total | 17 | 1 | 9 | 24 | 800 | | |
| **Semester II** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 EN 102 | Communication Skills | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 MA 102 | Engineering Mathematics II | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 CH 102 | Environmental Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 PH 101 | Engineering Physics | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 GE 101 | Fundamentals of Programming | 3 | 1 | 0 | 3 | 50 | 50 | 100 |
| 10 GE 110 | Basics of Electronics Engineering (CE, BT, MC, ME) | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 PH 100 | Engineering Physics Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 GE 1P2 | Fundamentals of Programming Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Total | | 18 | 2 | 6 | 23 | 800 | | |

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| Regulation | R 2010 | | | | | | | |
| Department | Department of Biotechnology | | | | | | | |
| Programme Code & Name | BT : B.Tech Biotechnology | | | | | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 MA 003 | Engineering Mathematics III | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 311 | Cell Biology and Genetics | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 312 | Biochemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 313 | Bioorganic Chemistry | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 314 | Industrial Microbiology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 315 | Principles of Chemical Engineering | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 3P1 | Biochemistry Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 3P2 | Bioorganic Chemistry Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 3P3 | Industrial Microbiology Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 TP 0P1 | Career Competency Development I | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| | Total | 18 | 2 | 11 | 26 | 1000 | | |
| **Semester IV** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 MA 004 | Probability and Statistics (BT, IT, ME, TT) | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 411 | Molecular Biology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 412 | Industrial Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 413 | Instrumentation Techniques | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 414 | Chemical Reaction Engineering | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 415 | Biochemical Thermodynamics | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 4P1 | Molecular Biology Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 4P2 | Instrumentation Techniques Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 4P3 | Chemical and Reaction Engineering Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 TP 0P2 | Career Competency Development II | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| | Total | 18 | 3 | 11 | 27 | 1000 | | |

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| Curriculum for the Programmes under Autonomous Scheme | | | | | | | | |
| Regulation | R 2010 | | | | | | | |
| Department | Department of Biotechnology | | | | | | | |
| Programme Code & Name | BT : B.Tech Biotechnology | | | | | | | |
| **Semester V** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 BT 511 | Food Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 512 | Genetic Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 513 | Bioinformatics | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 514 | Protein Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 515 | Enzyme Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 516 | Bioprocess Engineering and Technology | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 5P1 | Genetic Engineering Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 5P2 | Bioprocess Engineering Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 5P3 | Protein and Enzyme Engineering Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 TP 0P3 | Career Competency Development III | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| | Total | 18 | 2 | 11 | 26 | 1000 | | |
| **Semester VI** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 HS 001 | Professional Ethics | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 611 | Plant Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 612 | Animal Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 613 | Molecular Modeling and Drug Designing | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 614 | Heat and Mass Transfer Operations | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT E1* | Elective I | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 6P1 | Plant and Animal Biotechnology Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 6P2 | Industrial Biotechnology Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 6P3 | Bioinformatics and Molecular Modeling Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 TP 0P4 | Career Competency Development IV | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| | Total | 18 | 2 | 11 | 26 | 1000 | | |

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| Regulation | R 2010 | | | | | | | |
| Department | Department of Biotechnology | | | | | | | |
| Programme Code & Name | BT : B.Tech Biotechnology | | | | | | | |
| **Semester VII** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 HS 002 | Total Quality Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 711 | Immunology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 712 | Biopharmaceutical Technology | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT 713 | Nanobiotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 714 | Downstream Processing | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| 10 BT E2* | Elective II | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 7P1 | Immunology Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 7P2 | Downstream Processing Laboratory | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| 10 BT 7P3 | Project Work - Phase I | 0 | 0 | 4 | 2 | 100 | 00 | 100 |
| 10 TP 0P5 | Career Competency Development V | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| | Total | 18 | 2 | 12 | 26 | 1000 | | |
| **Semester VIII** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| | THEORY | | | | | | | |
| 10 HS 003 | Principles of Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT 811 | Entrepreneurship in Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E3* | Elective III | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E4* | Elective IV | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| | PRACTICAL | | | | | | | |
| 10 BT 8P1 | Project Work - Phase II | 0 | 0 | 16 | 8 | 50 | 50 | 100 |
| | Total | 12 | 0 | 16 | 20 | 500 | | |

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| Regulation | R 2010 | | | | | | | |
| Department | Department of Biotechnology | | | | | | | |
| Programme Code & Name | BT : B.Tech Biotechnology | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| **Electives I** | | | | | | | | |
| 10 BT E11 | Environmental Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E12 | Molecular Biophysics | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E13 | Principles of Biomedical Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E14 | Fundamentals of IT | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| **Electives II** | | | | | | | | |
| 10 BT E21 | Immunotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E22 | Marine Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E23 | Metabolic Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E24 | Basics of Stem Cells | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| **Electives III** | | | | | | | | |
| 10 BT E31 | Genomics and Proteomics | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E32 | Nanoscience and Technology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E33 | Cancer Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E34 | IT Essentials | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| **Electives IV** | | | | | | | | |
| 10 BT E41 | Tissue Engineering | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E42 | Clinical Trial Management | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E43 | Systems Biology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| 10 BT E44 | Textile Biotechnology | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| **One Credit Course*** | | | | | | | | |
| 10BTSE11 | Molecular Diagnosis and Regenerative Medicine | 1 | 0 | 1 | 1 | 50 | 50 | 100 |
| 10BT E12 | Clinical Research Management | 1 | 0 | 1 | 1 | 50 | 50 | 100 |
| 10BTSE13 | Medical Coding | 1 | 0 | 1 | 1 | 50 | 50 | 100 |

*students can select the course from forth semester onwards

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| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 EN 101 | TECHNICAL ENGLISH | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To improve learners vocabulary and to enable them to use words appropriately in different academic and professional contexts, familiarize learners with different rhetorical functions of Technical English, develop strategies that could be adopted while reading texts, acquire the ability to speak effectively in English in real-life and career related situations and train learners in organized academic and professional writing. | | | | | | | |
| 1 | GRAMMAR AND VOCABULARY | | | | Total Hrs | 9 | | |
| Word formation with prefixes and suffixes – synonyms and antonyms – verb patterns- subject-verb agreement – tenses – voices – use of conditionals – comparative adjectives (affirmative and negative) – expanding nominal compounds – articles – use of prepositions - phrasal verbs – British and American vocabulary – error detection – abbreviations and acronyms. | | | | | | | | |
| 2 | LISTENING | | | | Total Hrs | 9 | | |
| Extensive listening – listening for general content – listening to fill up gapped texts – intensive listening – listening for specific information: retrieval of factual information – listening to identify topic, context, function, speaker's opinion, attitude, etc. – global understanding skills and ability to infer, extract gist and understand main ideas – note-taking: guided and unguided | | | | | | | | |
| 3 | SPEAKING | | | | Total Hrs | 9 | | |
| Verbal and non verbal communication – speech sounds – syllables – word stress (structures and content words) – sentences stress – intonation – pronunciation drills, tongue twisters – formal and informal English – oral practice – developing confidence – introducing oneself – asking for or eliciting information – describing objects – expressing opinions (agreement / disagreement) – giving instructions | | | | | | | | |
| 4 | READING | | | | Total Hrs | 9 | | |
| Exposure to different reading techniques – reading for gist and global meaning – predicting the content – skimming the text – identifying the topic sentence and its role in each paragraph – scanning – inferring / identifying lexical and contextual meanings – reading for structure and detail – transfer of information / guided note-making – understanding discourse coherence – sequencing of sentences – cloze reading. | | | | | | | | |
| 5 | WRITING | | | | Total Hrs | 9 | | |
| Introductions to the characteristics of technical style – writing definitions and descriptions – paragraph writing (topic sentence and its role, unity, coherence and use of cohesive expressions) – process description (use of sequencing connectives) – comparison and contrast – classifying the data – analyzing / interpreting the data – formal letter writing (letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – editing (punctuation, spelling and grammar) | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1 | Rizvi M Ashraf, 'Effective Technical Communication', 1st Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Dr.M.Balasubraminian and Dr.G.Anbalagan, 'Performance in English' Anuradha Publications, Kumbakonan, 2007. | | | | | | | |
| 2 | Sharon J. Gerson, Steven M. Gerson, 'Technical Writing – Process & Product'. 3rd Edition, Pearson Education (Singapore) (p) Ltd., New Delhi, 2004. | | | | | | | |
| 3 | Mitra K. Barun, 'Effective Technical Communication – A Guide for Scientists and Engineers', Oxford University Press, New Delhi, 2006. | | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology | | | | | |
| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 MA 101 | ENGINEERING MATHEMATICS I | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | The course is aimed at developing the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and communication engineering. | | | | | | | |
| 1 | MATRICES | | | | Total Hrs | 12 | | |
| Column matrix as vector – linear independent and dependent of vector –Characteristic equation – Eigen values and Eigen vectors of a real matrix –Properties of eigen values and eigenvectors – Cayley – Hamilton theorem (without proof) – Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation. | | | | | | | | |
| 2 | GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS | | | | Total Hrs | 12 | | |
| Curvature – Cartesian and polar co-ordinates – Centre and radius of curvature – Circle of curvature – Involutes and evolutes – Envelopes – Properties of envelopes and evolutes –Evolute as envelope of normals. | | | | | | | | |
| 3 | FUNCTIONS OF SEVERAL VARIABLES | | | | Total Hrs | 12 | | |
| Functions of two variables – Partial derivatives – Total differential – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians. | | | | | | | | |
| 4 | ORDINARY DIFFERENTIAL EQUATIONS | | | | Total Hrs | 12 | | |
| Linear differential equations of Second and higher order with constant coefficient when the R.H.S is $e^{ax}$, $x^n$ n>0,sin ax , cos ax, $e^{ax}$ $x^n$ , $e^{\alpha x}$ Sinβx, $e^{\alpha x}$ cosβx, $x^n$ sinα x and $x^n$ cosα x – Differential Equations with variable coefficients (Cauchy's Form and Legendre's Linear Equation). | | | | | | | | |
| 5 | DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS | | | | Total Hrs | 12 | | |
| Simultaneous first order linear equations with constant coefficients – Method of variation of parameters – Solution of specified differential equations connected with electric circuits, bending of beams and simple harmonic motion (Differential equations and associated conditions need be given) | | | | | | | | |
| Total hours to be taught | | | | | | 60 | | |
| Text book(s) : | | | | | | | | |
| 1 | Veerarajan. T., "Engineering Mathematics (for first year), Fourth Edition Tata McGraw- Hill Publishing Company Limited, New Delhi, 2005. | | | | | | | |
| 2 | Grewal. B.S., "Higher Engineering Mathematics", Thirty Eighth Edition, Khanna Publishers, Delhi, 2004. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Kandasamy. P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics" – S.Chand and Co. – New Delhi 2007. | | | | | | | |
| 2 | Kreyszig. E., "Advanced Engineering Mathematics," Eighth Edition, John Wiley and Sons (Asia) Limited, Singapore 2001. | | | | | | | |
| 3 | Venkataraman.M.K, "Engineering Mathematics, Volume I & II Revised Enlarged Fourth Edition". | | | | | | | |

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|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology |

## Semester I

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 PH 105 | MATERIALS SCIENCE FOR BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | Impart fundamental knowledge in various engineering materials and applications, knowledge about crystal geometry, biomaterials, medical physics, instrumentation and Nanomaterials. | | | | | | | |

| | | | |
|---|---|---|---|
| 1 | CRYSTAL GEOMETRY | Total Hrs | 9 |

Crystal symmetry: centre plane and axis of symmetry- absence of five fold symmetry- HCP structures: coordination number, atomic radius, c/a ratio, packing factor-phase diagram-phase rule-unary, binary and ternary phase diagram (Qualitative)-Fe, Fe-C phase diagram- imperfection of crystals.

| | | | |
|---|---|---|---|
| 2 | BIOMATERIALS | Total Hrs | 9 |

Introduction-Biocompatibility – Biofunctionality – Metals and Alloys in Biomaterials – Ceramic biomaterials-composite biomaterials-Polymer biomaterials-Biopolymers-Tissue grafts – Soft tissue applications – Biomaterials in ophthalmology-Dental materials.

| | | | |
|---|---|---|---|
| 3 | MEDICAL PHYSICS | Total Hrs | 9 |

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

| | | | |
|---|---|---|---|
| 4 | INSTRUMENTATION | Total Hrs | 9 |

Basic concepts and blocks of instruments-Radiation sources and monochromators, sample cells and sampling devices, Detection and signal processing and readouts for UV-Vis, IR and Raman spectroscopy –Nuclear Magnetic Resonance(NMR)(Qualitative), Electron Spin Resonance(ESR)(Qualitative), Fourier Transform spectroscopy (Qualitative) and Particle size analyzer (Qualitative).

| | | | |
|---|---|---|---|
| 5 | NANOMATERIALS | Total Hrs | 9 |

Introduction-Properties-Fabrication methods-Top-Down Process – Ball milling-Nanolithography-Bottom-up Process-Vapour Phase Deposition(PVD & CVD)-Molecular Beam Epitaxy (MBE)-Metal Organic Vapour Phase Epitaxy(MOVPE)-Carbon Nano Tube(CNT):Properties, Preparation and applications

| | |
|---|---|
| Total hours to be taught | 45 |

Text Book:

| | |
|---|---|
| 1 | Arumugam M, “Engineering Physics-II”, Anuradha Publications, Kumbakonam, 2005. |

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|---|---|
| Reference (s) : | |
| 1 | Raghavan V, “Materials and Engineering”, Prentice-Hall of India, New Delhi, 2007. |
| 2 | www.howstuffworks.com |

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|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 CH 101 | ENGINEERING CHEMISTRY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | The student should be conversant with the principles involved in electro chemistry, corrosion and its inhibition, treatment of water for industrial purposes and the concept of energy storage devices, knowledge with respect to fuels and combustion and polymer and engineering materials. | | | | | | | |
| 1 | WATER TREATMENT | | | | Total Hrs | 9 | | |
| Water - sources and sanitary significance – Hardness of water - Estimation of hardness by EDTA method – Alkalinity. Boiler feed water- scale formation, corrosion, caustic embrittlement, priming and foaming- softening of water - Internal and external treatment - zeolite process – demineralization – desalination – electro dialysis and reverse osmosis. Domestic water treatment. | | | | | | | | |
| 2 | ELECTRO CHEMISTRY | | | | Total Hrs | 9 | | |
| Introduction – Kohlrausch's law- applications-conductometric titration-Electrode potential-Nernst equation-problems-Reference electrode-calomel electrode-SHE-weston cadmium cell-Types of electrodes-Measurement of pH using glass electrode-Galvanic series- emf series-applications. Electro chemical cells-concentration cells-reversible and irreversible cell – EMF - measurements – Potentiometric titrations | | | | | | | | |
| 3 | CORROSION & CORROSION CONTROL | | | | Total Hrs | 9 | | |
| Corrosion – Electrochemical and chemical – Mechanism – factors influencing rate of corrosion - corrosion reaction – types of corrosion – differential aeration – pitting – corrosion control – Sacrificial anode and Impressed current method – Inhibitors – Protective coatings – Preliminary treatment – Electroplating (Cr & Ni) – Paints – Constituents and their functions – Special paints - Mechanism of drying. | | | | | | | | |
| 4 | FUELS & COMBUSTION | | | | Total Hrs | 9 | | |
| Introduction-solid, liquid and gaseous fuels-Difference among solid, liquid and gaseous fuels-Explosive range(or) limits of inflammability-Calorific values –Spontaneous ignition temperature-flue gas analysis – Coal – analysis of coal– carbonization of coal-metallurgical coke - manufacture of metallurgical coke – hydrogenation of coal – petroleum – Cracking – Catalytic Cracking – Polymerisation - alkylation – Octane number – improving octane number by additives – Diesel – Cetane number –natural gas, water gas, producer gas, gobar gas & LPG. | | | | | | | | |
| 5 | POLYMERS | | | | Total Hrs | 9 | | |
| Polymer structure – Nomenclature – Polymerization – types – mechanism (free radical only) – co-ordination polymerization – mechanism – individual polymers – Polyethylene, Polypropylene, PVC, Teflon, Acrylics, Nylon6-6, Bakelite, Polyester, Epoxy, Polyurethane – Structure, Preparation, Properties and Uses – Compounding and fabrication – Compression, Injection, Extrusion and Blow moulding– Foamed plastics. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book : | | | | | | | | |
| 1. | R.Palanivelu, B.Srividhya, K.Tamilarasu and P.Padmanaban, "Engineering Chemistry", Sakura Publishers, Erode, 4th Edition, 2010. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Jain P.C. & Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Co. New Delhi, 14th Edition, 2002. | | | | | | | |
| 2. | Clair N Sawyer and Perry L Mc Carty, "Chemistry for Environmental Engineering", TMH Book Company, New Delhi, 14th Edition, 2002. | | | | | | | |
| 3. | Dara S.S. "A text book of Engineering Chemistry, S.Chand & Co. Ltd., 2003. | | | | | | | |
| 4. | Uppal M.M. revised by S.C.Bhatia, "Engineering Chemistry", Khanna Publishers, New Delhi, 6th Edition, 2001. | | | | | | | |
| 5 | www.howstuffworks.com | | | | | | | |

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester I</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 GE 102</td><td colspan="2">ENGINEERING GRAPHICS<br>(BT, CS, EC, EE, EI, IT)</td><td>2</td><td>0</td><td>3</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">Student’s skill in the graphical communication of concepts and ideas in the design of engineering products are to be obtained by training them to understand objects by making free hand sketches of simple engineering objects and computer 2D and 3D modeling techniques.</td></tr>
<tr><td colspan="9">Instructions:<br>1. Unit – I Free Hand Sketching<br>2. Unit – II to V, examination will be conducted using drafting software</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td>1</td><td colspan="6">INTRODUCTION TO ENGINEERING DRAWING (Free Hand Sketching)</td><td>Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Drawing Sheet Layouts - Title Block - Instruments used - Lines - Lettering – Dimensioning Construction of Pentagon, Hexagon, Conic Sections. Construction of Ellipse, Parabola and Hyperbola (Eccentricity method only) with tangent and normal Introduction to cycloid only and Involutes of square and circle. Introduction to Drafting Software</td></tr>
<tr><td>2</td><td colspan="6">ORTHOGRAPHIC PROJECTION(Using Drafting Software)</td><td>Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Theory of projection - Terminology, Method of projection, introduction of First angle and Third angle projection. Conversion of pictorial views into orthographic view. Projection of points in first quadrant.</td></tr>
<tr><td>3</td><td colspan="6">PROJECTION OF LINES AND PLANES(Using Drafting Software)</td><td>Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Projection of lines in first quadrant - parallel to one plane and inclined to other, true length, true inclinations. Projection of planes in first quadrant inclined to one plane – Triangular, Rectangular, Pentagonal, Hexagonal, Circular planes.</td></tr>
<tr><td>4</td><td colspan="6">PROJECTION OF SOLIDS AND SECTION OF SOLIDS(Using Drafting Software)</td><td>Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Projection of simple solids (axis is parallel to one plane) - Prisms, Pyramids, Cylinder and Cone using change of position method. Sectioning of above solids in simple position (base is on HP and axis perpendicular to HP) by cutting plane inclined to one reference plane, true shape of section.</td></tr>
<tr><td>5</td><td colspan="6">DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION(Using Drafting Software)</td><td>Total Hrs</td><td>12</td></tr>
<tr><td colspan="9">Development of lateral surfaces of simple and truncated solids - Prisms, Pyramids, Cylinders and Cones with square hole perpendicular to the axis. Principles of isometric projection. Isometric scale - isometric projections of simple solids, Prisms, Pyramids, Cylinders and Cones. Introduction to Perspective Projection (Not for examination)</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>60</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Kulkani D.M, Rastogi A.P, Sarkar A.K, “Engineering Graphics with AutoCAD”, PHI Learning Private Limited, New Delhi, 2009.</td></tr>
<tr><td>2</td><td colspan="8">Venugopal K., “Engineering Graphics”, New Age International (P) Limited, 2002.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Bhatt N.D., “Engineering Drawing”, Charotar Publishing House Pvt. Ltd., 49th Edition, Anand, Gujarat, 2006.</td></tr>
<tr><td>2</td><td colspan="8">Natarajan K.V., “A textbook of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006</td></tr>
<tr><td>3</td><td colspan="8">Shah M.B. and Rana B.C., “Engineering Drawing”, Pearson Education, 2005.</td></tr>
</table>

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 GE 108 | ELECTRICAL TECHNOLOGY (BT, CE) | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To expose the students in Electrical Engineering topics like electrical circuits, magnetic circuits, various sources of electrical power, electrical machines and measuring instruments for electrical quantities. | | | | | | | |
| 1 | ELECTRICAL CIRCUITS | | | | Total Hrs | 9 | | |
| Electric circuit elements - resistance, inductance and capacitance; Basic definitions - current, voltage, Energy, Power – Ohm,s law – Kirchoff's law – series and parallel resistances(simple problems using Kirchoff's Laws); Introduction to AC circuits- Instantaneous, RMS and average values of sine wave – form factor and peak factor – single phase and three phase balanced circuits – Phasor diagram (simple problems). | | | | | | | | |
| 2 | MAGNETIC CIRCUITS | | | | Total Hrs | 9 | | |
| Ohm's law of magnetic circuit – Simple and composite magnetic circuits – effect of air gap – leakage factor - Fringing effect (simple problems).<br>Faraday's law of electromagnetic induction – self and mutually induced emf – self and mutual inductances – statically and dynamically induced EMF (simple problems). | | | | | | | | |
| 3 | DC MACHINES & TRANSFORMERS | | | | Total Hrs | 9 | | |
| DC machines-Construction – principles of operation – EMF equation of DC generator – Torque equation of DC motor – Types – characteristics – applications; Single phase transformers-Construction – Types – Principle of operation – EMF equation – Regulation – efficiency; Three phase transformers – connections – Line and phase voltages / currents (simple problems). | | | | | | | | |
| 4 | AC MACHINES & MEASURING INSTRUMENTS | | | | Total Hrs | 9 | | |
| Induction motor-3 phase induction motor – Construction – Types – Principles of operation – Power flow diagram – applications; Single phase induction motor – Principles of operation - types – applications; synchronous machines – principles – construction – types - emf equation.<br>Construction and working principle of moving coil and moving iron instruments – Dynamo meter type watt meter – Induction type energy meter | | | | | | | | |
| 5 | POWER SYSTEM | | | | Total Hrs | 9 | | |
| Structure of electric power system – Sources of Electric Energy – Power Plants: Steam, Hydroelectric, Nuclear, Gas, Wind and Solar (Qualitative Treatment Only). House and industrial wiring materials – earthing – lightning arrester. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1 | R.Muthusubramaniam, S.Salivahanan and K A Muraleedharan, "Basic Electrical, Electronics and Computer Engineering", TMH 2007. | | | | | | | |
| 2 | Rajput R.K, "Power System Engineering", Laxmi Publications. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | S.P.Bihari and Bhu Pendra Sehgal, "Basic Electrical Engieering – Made Easy", Cengage learning. | | | | | | | |
| 2 | Del Tora 'Electrical Engineering Fundamentals' Pearson Education, New Delhi, 2007. | | | | | | | |
| 3 | Edward Hughes, "Electrical Technology", ELBS. | | | | | | | |
| 4 | www.howstuffworks.com | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 CH 100 | ENGINEERING CHEMISTRY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | Educate the theoretical concepts Experimentally | | | | | | | |

| Sl. No. | Name of the Experiment |
|---|---|
| 1 | Estimation of hardness of water by EDTA. |
| 2 | Estimation of alkalinity of water sample. |
| 3 | Estimation of chloride content in water sample. |
| 4 | Determination of dissolved oxygen in boiler feed water. |
| 5 | Determination of water of crystallization of a crystalline salt. |
| 6 | Conductometric titration of strong acid with strong base. |
| 7 | Conductometric titration of mixture of acids. |
| 8 | Precipitation titration by conductometric method. |
| 9 | Determination of strength of HCl by pH Meter. |
| 10 | Estimation of ferrous ion by potentiometric titration . |
| 11 | Determination of sodium and potassium in a water sample by flame photometry (Demo only). |
| 12 | Estimation of ferric ion by spectrophotometry (Demo only). |

| Total hours to be taught | 45 |
|---|---|

| Lab Manual : | |
|---|---|
| 1 | R.Palanivelu and B.Srividhya, “Engineering Chemistry Lab Manual”. |

| Reference(s) : | |
|---|---|
| 1 | J. Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel’s Text book of Quantitative Chemical Analysis, 6th Edition, Pearson Education, 2004. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology |

## Semester I

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 GE 1P1 | ENGINEERING PRACTICES LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |

| Objective(s) | To provide exposure to the students with hands on experience on various basic engineering practices in Mechanical Engineering |
|---|---|

| 1 | FITTING | Total Hrs | 9 |
|---|---|---|---|

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

| 2 | CARPENTRY | Total Hrs | 9 |
|---|---|---|---|

Safety aspects in Carpentry, Study of tools and equipments, Preparation of models- Planning, Tee Halving, Cross Lap, Wood turning.

| 3 | SHEET METAL | Total Hrs | 9 |
|---|---|---|---|

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

| 4 | WELDING | Total Hrs | 9 |
|---|---|---|---|

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

| 5 | ELECTRICAL WIRING AND PLUMBING | Total Hrs | 9 |
|---|---|---|---|

Safety aspects of Electrical wiring, Study of Electrical Materials and wiring components, Wiring circuit for a lamp using single and stair case switches. Wiring circuit for fluorescent lamps

Study of plumbing tools, Study of pipe connection with coupling and reducer.

| Total hours to be taught | 45 |
|---|---|

## I Semester - Course Outcomes

| Modules | 10 EN 101 - TECHNICAL ENGLISH<br>Course Outcomes (COs) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Comprehend the basic grammatical structures and generate new sentences in a given paradigm. |
| 2. | Explain and apply the enriched vocabulary in academic and professional contexts. |
| 3. | Identify the main idea and integrate it with supporting data to facilitate effective comprehension. |
| 4. | Infer, compare and summarize lexical & contextual meaning of various technical / general passages. |
| 5. | Recognize the basic phonetic units of language and execute it for better oral competency. |
| 6. | Retrieve information from various sources and construct a well designed descriptive writing. |
| 7. | Indentify the key words of concepts and learn to write definitions. |
| 8. | Categorize words into different parts of speech and use them in different contexts. |
| 9. | Recognize and interpret standard English Pronunciation & use it in diverse situations. |
| 10. | Find and classify different reading strategies and demonstrate letter articulation / expression. |

| Modules | 10 MA 101 - ENGINEERING MATHEMATICS I<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Evaluate the Eigen values and Eigen vectors of a real matrix |
| 2. | Reduce the quadratic form of the matrix to canonical form by orthogonal transformation. |
| 3. | Evaluate the Curvature, Centre of curvature, Radius of curvature and Circle of curvature |
| 4. | Find the Evolutes, Envelopes and the Envelope of normal's |
| 5. | Evaluate the Maxima and minima, Constrained maxima and minima of the function using Lagrange's multiplier method |
| 6. | Remember the concepts of Partial derivatives, Total differentiation and the Jacobians |
| 7. | Solve the Linear differential equations of Second and higher order with constant coefficients |
| 8. | Solve the Differential Equations with variable coefficients in Legendre's form and Cauchy's Form |
| 9. | Solve the Simultaneous differential equations of first order with constant coefficients |
| 10. | Solve the Differential Equations with variable coefficients by the Method of variation of parameters , connected with electric circuits, bending of beams and simple harmonic motion |

| Modules | 10 PH 105 - MATERIAL SCIENCE FOR BIO-TECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Understand the concepts of centre, plane and axis of symmetry , recognize absence of five fold symmetry |
| 2. | Analyse HCP structure, crystal imperfection, understand iron-carbide phase diagram |
| 3. | Understand the concepts of vacuum, throughput, pumping speed, effective pumping speed and conductance |
| 4. | Acquire knowledge of types of vacuum pumps and pressure gauges, explain their working principle and construction |
| 5. | Classify and compare the various magnetic materials, knowledge of the Heisenberg and Domain theory of ferromagnetism, analyze ferrites and its applications |
| 6. | Understand and explain magnetic tape, floppy disk, hard disk and bubble memory |
| 7. | Recognize smart materials such as Shape Memory Alloys(SMA), metallic glasses and microelectronic mechanical system (MEMS) |
| 8. | Understand the Fiber Reinforced Plastics (FRP) and Fiber Reinforced Metals(FRM) |
| 9. | Acquire knowledge of nanotechnology, explain top-down and bottom-up fabrication methods of nanomaterials like ball milling, nanolithography, PVD and CVD, MBE and MOVPE |
| 10. | Describe Carbon Nano Tubes, their properties, preparation and applications. |

| Modules | 10 CH 101 - ENGINEERING CHEMISTRY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Impart knowledge about hardness of water and its testing methods. |
| 2. | Outline of softening and desalination techniques. |
| 3. | Knowing the principles involved in electrochemistry. |
| 4. | To measure pH and potentiometric titrations. |
| 5. | Identify different types of corrosion. |
| 6. | Impart the knowledge about corrosion control &mechanism of drying of oil in paints. |
| 7. | Understand the analysis and combustion of fuels. |
| 8. | Ability to know about manufacture methods of solid, liquid and gaseous fuels. |
| 9. | Illustrate the preparation, properties and uses of polymeric materials. |
| 10. | Impart knowledge about hardness of water and its testing methods. |

| Modules | 10 GE 102 - Engineering Graphics<br>Course Outcomes (COs) |
|---|---|
| | **At the end of the course, the students will be able to** |
| 1 | Use instruments for drawing and demonstrate the lettering, lines and dimensioning. |
| 2 | Construct different shapes by eccentricity method. |
| 3 | Draw the orthographic projection |
| 4 | Convert pictorial view into orthographic view. |
| 5 | Draw the projection of lines using drafting software |
| 6 | Draw the projection of planes using drafting software |
| 7 | Draw the projection of simple solids using drafting software |
| 8 | Draw the sectional view of solids using drafting software |
| 9 | Develop the lateral surfaces of simple and truncated solids. |
| 10 | Draw the isometric projection of surfaces using drafting software |

| Modules | 10 GE 108 –Electrical Technology<br>Course Outcomes (COs) |
|---|---|
| | **At the end of the course, the students will be able to** |
| 1 | Demonstrate a basic understanding of physics in basic circuit elements. |
| 2 | Recall basic circuital laws in the field of electrical and electronics engineering and apply it to debug complex electrical circuits |
| 3 | Analyze and design simple circuits using a clearly defined system based approach to solve a specific problem. |
| 4 | Recognize the basic laws of magnetism and distinguish magnetic circuit from an electrical circuit. |
| 5 | Demonstrate an understanding of the differences in construction, performance and operation between the main topologies of electrical machines. |
| 6 | Select and employ techniques for analyzing electrical machines |
| 7 | Analyze various measuring techniques for electrical quantities. |
| 8 | Illustrate the concepts of indicating instruments for voltage, current and magnetic measurements. |
| 9 | Demonstrate an awareness of the sources of electrical energy and their sustainability |
| 10 | Describe the roles played by generation, transmission, distribution and utilization of modern electricity energy systems. |

| Modules | 10 CH 100 - ENGINEERING CHEMISTRY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Estimation of hardness of water by EDTA |
| 2. | Estimation of alkalinity of water sample |
| 3. | Determination of chloride content in water sample |
| 4. | Determination of dissolved oxygen in water. |
| 5. | Determination of water crystallization of a crystalline salt |
| 6. | Determination of Conductometric titration of strong acid with strong base |
| 7. | Determination of Conductometric titration of mixture of acids |
| 8. | Determination of Precipitation titration by conductometric method |
| 9. | Determination of strength of HCl by pH Meter |
| 10. | Estimation of ferrous ion by potentiometric titration |

| odules | 10 GE 1P1 - ENGINEERING PRACTICES LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Perform the safety aspects of fitting, study of tools and equipments |
| 2. | Fabricate the models of square and vee joint using fitting tools |
| 3. | outline safety aspects of carpentry tools and equipments |
| 4. | Make the models of tee halving and cross lap joints using carpentry tools/equipments |
| 5. | Outline the Safety aspects of sheet metal tools and equipments |
| 6. | Prepare the model like cylinder, cone and tray in sheet metal shop |
| 7. | outline safety aspects of welding |
| 8. | Practice the welding operations used in mechanical industries |
| 9. | Perform the safety aspects of fitting, study of tools and equipments |
| 10. | Fabricate the models of square and vee joint using fitting tools |

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<tr><td colspan="2">Department</td><td colspan="2">Biotechnology</td><td>Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester II</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 EN 102</td><td>COMMUNICATION SKILLS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To equip students with effective speaking and listening skills in English, help them develop the soft skills and people skills which will make them to excel in their jobs and enhance to students' performs at placement interviews</td></tr>
<tr><td>1</td><td colspan="5">LISTENING</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Barriers in Listening - Listening to academic lectures - Listening to announcements at railway stations, airports, etc - Listening to news on the radio / TV - Listening to casual conversation - Listening to live speech</td></tr>
<tr><td>2</td><td colspan="5">COMMUNICATION</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">What is communication? - What does it involve? Accuracy, fluency and appropriateness - Levels of formality - Differences between spoken and written communication - Greeting and introduction - Making requests - Asking for permission, Giving / Denying permission - Giving directions - Art of small talk - Taking part in casual conversation - Making a short formal speech Describing people, place, things and events</td></tr>
<tr><td>3</td><td colspan="5">CONVERSATION SKILLS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Using the telephone - Preparing for a call - Stages of a call - Handling calls - Identifying self – Asking for repetitions - Spelling out names or words - Giving information on the phone – Making requests - Answering calls - Leaving messages on Answer Machines - Making / changing appointments - Making complaints – Reminding - Agreeing / Disagreeing – Listening - Listening and Taking messages - Giving instructions & Responding to instructions</td></tr>
<tr><td>4</td><td colspan="5">REMEDIAL GRAMMAR & VOCABULARY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Tenses - 'Do' forms – Impersonal Passive voice - Imperatives – using should form – Direct, Indirect speech – Discourse markers – SI Units – Numerical expressions - Use of negatives – Prepositions - Phrasal verbs - Correct use of words - Use of formal words in informal situations - Commonly confused words – Editing.</td></tr>
<tr><td>5</td><td colspan="5">WRITTEN COMMUNICATION & CAREER SKILLS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Writing e-mails - Writing Reports – Lab Reports - Preparing Curriculum Vitae and cover letters – Facing an Interview - Presentation skills - Persuasion skills – Flow Charts, Tree diagram – Recommendations – Check List – Slide Preparation – Verbal Reasoning (Analogy, Alphabet Test, Assertion & Reason, Situation Reaction Test) – Logical Deduction (Deriving Conclusions from passages, Theme Detection, Cause and Effect Reasoning).</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Rizvi M Ashraf, 'Effective Technical Communication', 1st Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Kiranmai Dutt P, Geetha Rajeevan and Prakash C L N, 'A Course in Communication Skills', by Ebek – Cambridge University Press India Pvt. Ltd.</td></tr>
<tr><td>2</td><td colspan="8">Naterop, cup 'Telephoning in English' – Cambridge University Press India Pvt.Ltd., 2007</td></tr>
<tr><td>3</td><td colspan="8">Richard, 'New Interchange Services (Student's Book)' – Introduction, Level – 1, Level – 2, Level – 3, Cambridge University Press India Pvt.Ltd., 2007.</td></tr>
<tr><td>4</td><td colspan="8">Aggarwal, R.S. "A Modern Approach to Verbal and Non-verbal Reasoning", Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester II** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 MA 102 | ENGINEERING MATHEMATICS II | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | An aim of the course is to train the students in additional areas of engineering mathematics necessary for grooming them into successful engineers. The topics introduced will serve as basic tools for specialized studies in many engineering fields, significantly in fluid mechanics, field theory and communication engineering. | | | | | | | |
| 1 | MULTIPLE INTEGRALS | | | | Total Hrs | 12 | | |
| Double integration in Cartesian and Polar coordinates – Change of order of integration – Area between two curves – Area as double integrals - Triple integration in Cartesian coordinates – Volume as triple integrals (simple problems only) . | | | | | | | | |
| 2 | VECTOR CALCULUS | | | | Total Hrs | 12 | | |
| Gradient, divergence and curl – Line, surface and volume integrals – Green's, Gauss divergence and Stoke's theorems (without proof) – Verification of the above theorems and evaluation of integrals using them. | | | | | | | | |
| 3 | ANALYTIC FUNCTIONS | | | | Total Hrs | 12 | | |
| Function of a complex variable – Analytic function – Necessary conditions –Polar form– Cauchy–Riemann equations – Sufficient conditions (excluding proof) – Properties of analytic function – Harmonic conjugate – Construction of Analytic functions -Conformal mapping: w = az, 1/z and bilinear transformation. | | | | | | | | |
| 4 | COMPLEX INTEGRATION | | | | Total Hrs | 12 | | |
| Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor and Laurent series (without proof) – Singularities – Classification – Cauchy's residue theorem – Contour integration – circular and semi-circular contours (excluding poles on real axis). | | | | | | | | |
| 5 | LAPLACE TRANSFORM | | | | Total Hrs | 12 | | |
| Laplace Transform – Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Solution of linear ODE of second order with constant coefficients and first order simultaneous equations with constant coefficients using Laplace transformation. | | | | | | | | |
| Total hours to be taught | | | | | | 60 | | |
| Text book(s) : | | | | | | | | |
| 1 | Veerarajan. T., "Engineering Mathematics (for first year), Fourth Edition Tata McGraw- Hill Publishing Company Limited, New Delhi, 2005. | | | | | | | |
| 2 | Grewal. B.S., "Higher Engineering Mathematics", Thirty Eighth Edition, Khanna Publishers, Delhi, 2004. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Kandasamy. P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics" – S.Chand and Co. New Delhi 2007. | | | | | | | |
| 2 | Venkataraman.M.K, "Engineering Mathematics, Volume I & II Revised Enlarged Fourth Edition", The National Pub. Co., Chennai, 2004. | | | | | | | |
| 3 | Widder. D.V., "Advanced Calculus", Second Edition, Prentice Hall of India, New Delhi, 2000. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | | Programme Code & Name | | BT : B.Tech Biotechnology | | | |
| **Semester II** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 CH 102 | ENVIRONMENTAL ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | The student should be conversant with the evolution of environmentalism and the importance of environmental studies, various natural resources and the current threats to their sustainability, significance and protection of bio diversity and various forms of environmental degradation and international conventions and protocols for the protection of environment. | | | | | | | |
| 1 | ATMOSPHERE AND ECOSYSTEM | | | | Total Hrs | 9 | | |
| Atmosphere – composition of atmosphere (troposphere, stratosphere, mesosphere and thermosphere) - Ozone and ozone depletion – Air pollution – sources, effects and control – Green house effect - Global warming – Climate change – Acid rain - Planet Earth – Biosphere – Hydrosphere – Lithosphere. Concept of ecosystem – structure and functions of ecosystem-producers, consumers and decomposers - Energy flow –Ecological succession-Food chains-Food webs- Ecological pyramids-Introduction, types, characteristic features-structures and function of forest, grassland and aquatic ecosystems (ponds and rivers) - Case Studies in current scenario. | | | | | | | | |
| 2 | WATER RESOURCES AND ITS TREATMENT | | | | Total Hrs | 9 | | |
| Water – hydrological cycle – ground water – water shed – water use and quality – point and non-point sources of pollution – Oceans and fisheries – salinity – temperature – density – pressure – light – bioluminescence – Tsunamis – Glaciers – Water pollution – dissolved oxygen – surface water treatment – waste water treatment – Thermal pollution, noise pollution and control - Case Studies in current scenario. | | | | | | | | |
| 3 | LAND RESOURCES AND ITS DEGRADATION | | | | Total Hrs | 9 | | |
| Land – weathering and erosion - types of weathering – types of soil – soil erosion – land slides – Wet land and deforestation- deserts – types – desertification – land degradation – features of desert – geochemical cycling – solid and hazardous waste, chemical waste, radio active waste – non hazardous waste - Case Studies in current scenario. | | | | | | | | |
| 4 | FUTURE POLICY AND ALTERNATIVES | | | | Total Hrs | 9 | | |
| Future policy and alternatives – fossil fuels – nuclear energy – solar energy – wind energy – hydroelectric energy – geothermal energy – tidal energy – sustainability – green power – nano technology – international policy - Case Studies in current scenario. | | | | | | | | |
| 5 | BIO DIVERSITY AND HUMAN POPULATION | | | | Total Hrs | 9 | | |
| Introduction to Bio diversity-Definition, genetic species and ecosystem diversity. Biogeographical classification of India – Biodiversity in India – India as mega diversity nation – hotspots of biodiversity in India – threats to biodiversity – endemic and endangered- habitat – conservation of biodiversity – environment protection act – issues and possible solution – population growth - population explosion – environment and human health - HIV-AIDS- Case Studies in current scenario. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book : | | | | | | | | |
| 1. | R.Palanivelu and B.Srividhya, “Environmental Engineering:, Sakura Publishers, Erode, 4th Edition, 2010. | | | | | | | |
| References : | | | | | | | | |
| 1. | Linda D. Williams – “Environmental Science Demystified”, Tata McGraHill Publishing Company Limited, 2005. | | | | | | | |
| 2. | G. Tyler Miller, JR _ “Environmental Science “, Thomson, 2004. | | | | | | | |
| 3. | William P. Cunningham – “Principles of Environmental Science”, Tata McGraHill, New Delhi, 2007. | | | | | | | |
| 4. | Bharucha Erach –“The Biodiversity of INDIA”, Mapin Publishing Private Limited, Ahamedabad, India. | | | | | | | |
| 5. | Trivedi R.K., “Hand Book of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Volume I & II, Environmedia. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |

## Semester II

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 PH 101 | ENGINEERING PHYSICS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To enhance students' knowledge of theoretical and modern technological aspects in physics, enable the students to correlate the theoretical principles with application oriented studies. | | | | | | | |

| 1 | ACOUSTICS OF BUILDING AND SOUND INSULATION | Total Hrs | 9 |
|---|---|---|---|

Introduction-Classification of sound – Characteristics of musical sound – sound intensity level – Weber-Fechner law –Bel, Decibel, Phon, Sone – Acoustics of building - Reverberation – Reverberation time – Sabine's formula – Absorption co-efficient (derivation)– Factors affecting the acoustics of buildings and their remedies- Factors to be followed for good acoustics of building.

| 2 | LASER AND APPLICATIONS | Total Hrs | 9 |
|---|---|---|---|

Introduction – Principle of spontaneous emission, stimulated absorption and emission – Einstein's co-efficient (derivation)– Types of lasers: Nd:YAG, Semiconductor laser (homo junction and hetro junction), $CO_2$ laser – Applications: Lasers in welding, cutting, drilling and soldering- medical applications: laser endoscopy, bloodless surgery – Holography: Construction and reconstruction of hologram –applications.

| 3 | FIBER OPTICS AND SENSORS | Total Hrs | 9 |
|---|---|---|---|

Principles – cone of acceptance, numerical aperture (derivation)- Modes of propagation – Concept of bandwidth (Qualitative)- Crucible-crucible technique –zone refining (rod and tube method)- Classification based on materials, refractive index and modes– Splicing – Losses in optical fiber – Light sources for fiber optics – Detectors – Fiber optical communication links – Advantage of fiber optical cable over copper cables- Fiber optic sensors: Temperature, Displacement, Voltage and magnetic field measurement.

| 4 | ULTRASONICS AND APPLICATIONS | Total Hrs | 9 |
|---|---|---|---|

Introduction: Production of ultrasonic waves – Magnetostriction effect, magnetostriction generator-inverse piezoelectric effect, piezoelectric generator – Ultrasonic detection, properties, cavitation-acoustical grating- Industrial applications: Cleaning, SONAR, depth of sea – Non destructive testing – Pulse echo system, through transmission, resonance system- Medical applications:cardiology, neurology, ultrasonic imaging.

| 5 | QUANTUM PHYSICS AND APPLICATIONS | Total Hrs | 9 |
|---|---|---|---|

Development of Quantum theory – Dual nature of matter and radiation – de-Broglie wave length – Uncertainty principle, applications: single slit experiment, electron microscope - Schrodinger's equation time dependent and time independent – Particle in a box(one dimensional and three dimensional)- limitation of optical microscopy –electron microscope- Scanning electron microscope-transmission electron microscope-scanning transmission electron microscope-applications.

| Total hours to be taught | 45 |
|---|---|

Text Book:

| 1. | Dr.Palanisamy P.K, "Engineering Physics", Scitech Publications, Chennai, 2010. |
|---|---|

Reference (s) :

| 1 | Pillai S O, "Engineering Physics", New Age International Publishers, New Delhi, 2005. |
|---|---|
| 2 | Rajendran V, "Engineering Physics", Tata McGraw-Hill Publishers, New Delhi, 2008 |
| 3 | www.howstuffworks.com |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology | | | | | | |
| **Semester II** | | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | | |
| | | L | T | P | C | CA | ES | Total | |
| 10 GE 101 | FUNDAMENTALS OF PROGRAMMING | 3 | 1 | 0 | 3 | 50 | 50 | 100 | |
| Objective(s) | To enable students to learn the basic concepts of computer and developing skills in programming using C language. | | | | | | | | |
| 1 | COMPUTER BASICS | | | | Total Hrs | 8 | | | |
| Evolution of computers- Generations of computers- Applications of computers- - Computer Memory and Storage- Input Output Media – Algorithm- Flowchart- Pseudo code – Program control structures- - Programming languages- - Computer Software- Definition- Categories of Software. | | | | | | | | | |
| 2 | C FUNDAMENTALS | | | | Total Hrs | 9 | | | |
| Introduction to C- Constants- Variables- Data types- Operators and Expressions- Managing Input and Output operations- Decision Making and Branching- Looping. | | | | | | | | | |
| 3 | ARRAYS AND FUNCTIONS | | | | Total Hrs | 10 | | | |
| Arrays- Character Arrays and Strings- User defined functions- Storage Classes | | | | | | | | | |
| 4 | STRUCTURES AND FILES | | | | Total Hrs | 10 | | | |
| Structures- Definition- Initialization- Array of Structures- Structures within structures- Structures and Functions- Unions- File Management. | | | | | | | | | |
| 5 | POINTERS | | | | Total Hrs | 8 | | | |
| Pointer Basics – Pointer Arithmetic – Pointers and array Pointers and character string Pointers and functions – Pointers and structures. | | | | | | | | | |
| Total hours to be taught | | | | | | 45+15(Tutorial)=60 | | | |
| Text book(s) : | | | | | | | | | |
| 1 | Dr.K.Duraisamy, R.Nallusamy, R.Kanagavalli, S.Ponmathangi, D.Muthusankar, P.Kaladevi, “Fundamentals of Programming”, Techvision Publishers 2008. | | | | | | | | |
| 2 | E.Balagurusamy, “Programming in ANSI C”, TMH, New Delhi, 2002. | | | | | | | | |
| Reference(s): | | | | | | | | | |
| 1 | Rajaraman V, “Fundamentals of Computers”, Fourth Edition, PHI 2006. | | | | | | | | |
| 2 | Byron Gottfried, “Programming with C”, II Edition, TMH, 2002. | | | | | | | | |

<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Semester II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 GE 110</td><td>BASICS OF ELECTRONICS ENGINEERING (CE, BT, MC, ME)</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">To Introduce fundamentals of Electron Devices, integrated Circuits and Communication Engineering</td></tr>
<tr><td>1</td><td colspan="4">SEMICONDUCTOR THEORY AND PN JUNCTION DIODE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Energy bands - conduction in solids-conventional current and electron flow - bonding forces between atoms-conductors, insulators and semiconductors - p-type and n-type semiconductors - effects of heat and light-drift current and diffusion current - the PN junction - forward biased junction - reverse biased junction - temperature effects. Diode characteristics and parameters - diode fabrication and packaging -graphical analysis of diode circuits- ideal diode and practical diode.</td></tr>
<tr><td>2</td><td colspan="4">APPLICATIONS OF DIODE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Rectification – half wave, full wave and bridge rectifiers. Ripple factor, output waveforms, average output voltage, RMS voltage and current, simple problems. Diode logic circuits - power dissipation in diodes - diode clipping and clamping circuits - diode testing. Zener diode - Zener diode as voltage regulator.</td></tr>
<tr><td>3</td><td colspan="4">BIPOLAR JUNCTION TRANSISTORS AND FIELD EFFECT TRANSISTORS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Introduction - transistor operation - transistor currents - transistor terminal voltages - common base characteristics - common emitter characteristics - common collector characteristics - transistor voltage amplification - transistor as switch - class A, B, C operations (only definitions ), waveforms, applications. Field effect transistors. The n channel JFET - characteristics of an n channel JFET - the p channel JFET- FET voltage amplification- JFET construction - MOSFET.</td></tr>
<tr><td>4</td><td colspan="4">INTEGRATED CIRCUITS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Linear integrated circuits - operational amplifier – circuit symbol – inverting / non inverting amplifier - gain – adder - differentiator – integrator. Digital integrated circuits - Number system – binary, octal, hexadecimal - Boolean algebra - logic gates – flip flops - shift registers - counters.</td></tr>
<tr><td>5</td><td colspan="4">BASICS OF COMMUNICATION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre and Mobile communication. (Block Diagram Approach only)</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="7">David A.Bell ‘Electronic Devices and Circuit - Oxford University Press , 2008. (Chapter 1,2 ,3, 8,16 )</td></tr>
<tr><td>2</td><td colspan="7">Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, (2006). (chapter 13)</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="7">R.S. Sedha, “Applied Electronics” S. Chand & Co., 2006.</td></tr>
<tr><td>2</td><td colspan="7">Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd.</td></tr>
<tr><td>3</td><td colspan="7">www.howstuffworks.com</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology |

## Semester II

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 PH 100 | ENGINEERING PHYSICS LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |

| Objective(s) | To give exposure for understanding the various physical phenomena's in optics, acoustics material science and properties of matter in engineering applications, determine the fundamental constants like acceleration due to gravity, viscosity of liquid, wave length of laser, band gap of semiconductor etc., |
|---|---|

LIST OF EXPERIMENTS

| | |
|---|---|
| 1 | Determination of rigidity modulus of a wire by torsional pendulum. |
| 2 | Determination of Young's modulus of the material of a uniform bar by non-uniform bending method. |
| 3 | Determination of Young's modulus of the material of a uniform bar by uniform bending method. |
| 4 | Determination of Viscosity of liquid by Poiseuille's method. |
| 5 | Determination of acceleration due to gravity by compound (bar) pendulum. |
| 6 | Determination of wavelength of mercury spectrum by Spectrometer grating. |
| 7 | Determination of thickness of fiber by Air-wedge method. |
| 8 | Determination of wavelength of laser using grating and particle size determination. |
| 9 | Determination of velocity of ultrasonic waves and compressibility using ultrasonic interferometer. |
| 10 | Determination of band gap energy of a semiconductor. |
| 11 | Determination of radius of curvature of a Plano convex lens by Newton rings method. |
| 12 | Determination of acceptance angle numerical aperture using fibre optics. |
| | Total hours to be taught: 45 |

Lab Manual :

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

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| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology |

**Semester II**

| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 GE 1P2 | FUNDAMENTALS OF PROGRAMMING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | To enable the students to apply the concepts of C to solve real time problems | | | | | | | |

LIST OF EXPERIMENTS

1. Write a C program to print Pascal's triangle.
2. Write a C program to print the sine and cosine series.
3. Write a C program to perform Matrix multiplication.
4. Write a C program to prepare and print the sales report.
5. Write a C program to perform string manipulation functions like string concatenations, comparison, find the length and string copy without using library functions.
6. Write a C program to arrange names in alphabetical order.
7. Write a C program to calculate the mean, variance and standard deviation using functions.
8. Write a C program to perform sequential search using functions.
9. Write a C program to print the Fibonacci series and to calculate the factorial of the given number using functions.
10. Write a C program to print the mark sheet of n students using structures.
11. Write a C program to merge the given two files.
12. Write a C Program to perform Swap Using Pointers.

| Total hours to be taught | 45 |
|---|---|

## I Semester - Course Outcomes

| Modules | 10 EN 102 - COMMUNICATION SKILLS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Comprehend the basic grammatical structures and generate new sentences in a given paradigm. |
| 2. | Explain and apply the enriched vocabulary in academic and professional contexts. |
| 3. | Identify the main idea and integrate it with supporting data to facilitate effective comprehension. |
| 4. | Infer, compare and summarize lexical & contextual meaning of various technical / general passages. |
| 5. | Recognize the basic phonetic units of language and execute it for better oral competency. |
| 6. | Retrieve information from various sources and construct a well designed descriptive writing. |
| 7. | Indentify the key words of concepts and learn to write definitions. |
| 8. | Categorize words into different parts of speech and use them in different contexts. |
| 9. | Recognize and interpret standard English Pronunciation & use it in diverse situations. |
| 10. | Find and classify different reading strategies and |

| Modules | 10 MA 102 - ENGINEERING MATHEMATICS II<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Find the Double Integral ,Triple integral, Area as a double integral and the Volume as triple integral |
| 2. | Solve the Integrals using Change of order of integration and Change into Polar coordinates |
| 3. | Find the Gradient, divergence, curl, Line, surface and volume integrals |
| 4. | Solve the function using Gauss divergence, Stokes and Green's theorem |
| 5. | Define Analytic functions and the Properties of analytic functions |
| 6. | Construct an analytic functions and discuss about the different types of Transformations |
| 7. | Define Cauchy's integral theorem, Cauchy's integral formula Cauchy's residue theorem, Taylor's &Laurent's Series, Singularities, Contour integration |
| 8. | Solve the Integrals and the functions using Cauchy's integral theorem, Cauchy's integral formula, Cauchy's residue theorem, Taylor's &Laurent's Series, Contour integration |
| 9. | Remember the fundamentals of Laplace transform and inverse Laplace transform |
| 10. | Solve the ordinary differential equations of different types using Laplace transform and inverse Laplace transform |

| Modules | 10 CH 102 - ENVIRONMENTAL ENGINEERING<br>Course Outcomes( Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Impart the knowledge of our earth and atmosphere |
| 2. | Understands the ecosystem of various lifestyles |
| 3. | Importance of water and its management techniques |
| 4. | Sources of water pollution and their treatments |
| 5. | Identify the biogeochemical cycle of different biogenic salts |
| 6. | Impart the knowledge about hazardous and non hazardous wastes |
| 7. | Outline the future policy and alternate fuels |
| 8. | Understands about nanotechnology and international policy to protect environment. |
| 9. | Learns about biodiversity and hot spots of India and its reasons |
| 10. | Knowing the awareness about population and human health |

| Modules | 10 PH 101 - ENGINEERING PHYSICS<br>Course Outcomes (COs) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Analyse the characteristics of sound and noise with proper units |
| 2. | Evaluate reverberation time of sound from Sabine's formula and demonstrate its application to acoustics of building |
| 3. | Understand the laser properties & describe the types of laser |
| 4. | Evaluate the Einstein's co-efficients for lasing action and impart the applications of laser |
| 5. | Understand the fiber optic principles, explain fiber fabrication and its classification |
| 6. | Analyse the fiber losses, describe the light sources and detectors, demonstrate the fiber optic sensors and applications |
| 7. | Comprehend the basics of ultrasonics, describe the production and detection of ultrasonics |
| 8. | Recognize the cavitation effect and explain industrial applications like Non-Destructive Testing and medical applications |
| 9. | Acquire knowledge of development of quantum theory, dual nature of matter and radiation, de-Broglie wave theory, Uncertainty principle |
| 10. | Arrive at the Schrodinger's wave equations and their applications , understand the limitations of optical microscope and recognizing the differences between electron microscopes - SEM,TEM and STEM |

| Modules | 10 GE 101 - FUNDAMENTALS OF PROGRAMMING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Recognize the origin and evolution of computers, generations of computers and the applicability of computer system in various fields. |
| 2. | Describe about algorithms, Pseudo code, various flow chart symbols, different programming control structures and types of software. |
| 3. | Capture the fundamentals of C - Constants, Variables and Data types, different operators and Expressions in C language. |
| 4. | Describe different Input and Output operations with different formats and programs using different Branching and Looping statements. |
| 5. | Narrate the basic concept of Array, types of array, character arrays and strings and able to write programs using array concepts. |
| 6. | Obtain knowledge about user defined functions and scope of variables in C. |
| 7. | Comprehend basic concept of Structure, nested structures and Union. |
| 8. | Identify the concept of File, File operations and Types of files. |
| 9. | Grasp the basics of pointers and its operation and implement the concepts of Pointers and arrays, Pointers and Character Strings. |
| 10. | Illustrate the concepts of Pointers and functions & Pointers and Structures. |

| Modules | 10 GE 110 - BASICS OF ELECTRONICS ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the fabrication formation of PN junction and its characteristics when biased |
| 2. | Describe the basic theory of semiconductors. |
| 3. | Explain the various applications of PN diode. |
| 4. | Describe the characteristics and applications of Zener diode |
| 5. | Explain the construction and working of bipolar junction transistor in various configurations and as an amplifier. |
| 6. | Discuss the construction and working of FET in various configurations. |
| 7. | Describe the characteristics and applications of an Op-Amp |
| 8. | Explain the need for modulation and its types with relevant applications. |
| 9. | Design the concept of AM, FM radio and commercial TV broadcasting and reception. |
| 10. | Explain the building blocks of communication systems |

| Modules | 10 PH 100 - ENGINEERING PHYSICS LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Determine Rigidity modulus of a wire by torsional pendulum |
| 2. | Determine Young's modulus of the material of a uniform bar by non-uniform bending method |
| 3. | Determine Young's modulus of the material of a uniform bar by uniform bending method |
| 4. | Determine viscosity of liquid by Poiseuille's method |
| 5. | Determine acceleration due to gravity by compound (bar) pendulum |
| 6. | Determine wavelength of mercury spectrum by Spectrometer grating |
| 7. | Determine thickness of fiber by Air wedge method |
| 8. | Determine wavelength of laser and particle size using grating |
| 9. | Determine velocity of ultrasonic waves and compressibility of liquid using ultrasonic interferometer |
| 10 | Determine the band gap energy of a semiconductor. |

| Modules | 10 GE 1P2 - FUNDAMENTALS OF PROGRAMMING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate the ability to use the editor, compiler, and linker to create source, object, and executable code and debugging of a simple 'C' program. |
| 2. | Familiarize with simple programs involving the fundamental programming constructs (variables, data types, expressions, assignment, simple I/O). |
| 3. | Gain the knowledge of the data types appropriate to specific programming problems. |
| 4. | Demonstrate the use of appropriate conditional and iteration constructs for a given programming task. |
| 5. | Use various string handling functions and arrays as part of the problem solution. |
| 6. | Implement the concept of structure data type as part of the solution. |
| 7. | Elucidate the concept of functions from the portable C library and Mastering the mechanics of parameter passing, Fibonacci series using recursive function. |
| 8. | Utilize pointers to efficiently solve problems, swap two integers without using third variable. |
| 9. | Design programs using file concepts |
| 10. | Demonstrate the ability to design, develop, and implement a fully functioning 'C' programming using structured techniques and reusable code. |

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| Department | Biotechnology | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 MA 003 | ENGINEERING MATHEMATICS III | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | The course aims to develop the skills of the students in the areas of boundary value problems and transform techniques. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research. | | | | | | | |
| 1 | PARTIAL DIFFERENTIAL EQUATIONS | | | | Total Hrs | 12 | | |
| Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients. | | | | | | | | |
| 2 | FOURIER SERIES | | | | Total Hrs | 12 | | |
| Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis. | | | | | | | | |
| 3 | BOUNDARY VALUE PROBLEMS | | | | Total Hrs | 12 | | |
| Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Fourier series solutions in Cartesian coordinates | | | | | | | | |
| 4 | FOURIER TRANSFORM | | | | Total Hrs | 12 | | |
| Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Problems. | | | | | | | | |
| 5 | Z -TRANSFORM AND DIFFERENCE EQUATIONS | | | | Total Hrs | 12 | | |
| Z-transform - Elementary properties – Initial and final value theorem – Inverse Z – transform – Convolution theorem – Solution of difference equations using Z - transform. | | | | | | | | |
| Total hours to be taught | | | | | | 60 | | |
| Text book (s) : | | | | | | | | |
| 1. | Veerarajan, T., "Engineering Mathematics (for first year), Fourth Edition Tata McGraw- Hill Publishing Company Limited, New Delhi, 2005. | | | | | | | |
| 2. | Grewal, B.S., "Higher Engineering Mathematics", Thirty Eighth Edition, Khanna Publishers, Delhi, 2004. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Kandasamy, P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics" – S.Chand and Co. – New Delhi 2007. | | | | | | | |
| 2. | Kreyszig, E., "Advanced Engineering Mathematics," Eighth Edition, John Wiley and Sons (Asia) Limited, Singapore 2001. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 311 | CELL BIOLOGY AND GENETICS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | Pre- requisite - Basic knowledge in Life sciences. At the end of the course, the students would have gained extensive knowledge in cell structure, functions, cell signaling pathways and transfer across membranes in cells. | | | | | | | |
| 1 | STRUCTURE AND ORGANELLES OF CELL | | | | | Total Hrs | | 9 |
| The structure of plant and animal cells, Molecular organization of cells, Organization of different cell organelles: Endoplasmic reticulum, Golgi apparatus and Lysosomes, Mitochondria, Chloroplast, Peroxisomes, Interphase Nucleus, Nuclear envelope, Chromatin, Chromosome and hetero and euchromatin. | | | | | | | | |
| 2 | TRANSPORT ACROSS CELL MEMBRANES | | | | | Total Hrs | | 9 |
| The Cell membrane- composed of proteins, lipids and carbohydrates, membrane proteins, Molecular models of cell membrane, cell permeability and cell division: different stages of Mitosis and Meiosis, Cell cycle; Molecules that control cell cycle. | | | | | | | | |
| 3 | MENDELISM AND THE CHROMOSOMAL THEORY | | | | | Total Hrs | | 9 |
| Mendel's principles: Mendel's experiments, segregation, multiple alleles: Independent Assortments (Test cross and back cross), Genotypic interactions, epistasis, and inborn error of metabolism. Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis. | | | | | | | | |
| 4 | CYTOGENETICS AND MUTATIONS | | | | | Total Hrs | | 9 |
| Variation in chromosomal structure: deletion, inversion, translocation, duplication. variation in chromosomal numbers: aneuploidy, euploidy, polyploidy. Mutations: types of mutations, mutagenesis, Ionizing and non ionizing radiation. Ames test. | | | | | | | | |
| 5 | POPULATION GENETICS AND EVOLUTION | | | | | Total Hrs | | 9 |
| Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium, non random mating, population analysis, Models for population genetics. Mutation and Migration size. Natural selection. Evolution: Darwinian evolution, Speciation, Genetic variation and Sociobiology. | | | | | | | | |
| Total Hours Taught | | | | | | | | 45 |
| Text book (s) : | | | | | | | | |
| 1. | Tamarin, R.H., "Principles of Genetics", Tata McGraw Hill, New Delhi, 2002. | | | | | | | |
| 2. | De Robertis, E. D. P. and De Robertis, E. M. F., "Cell and Molecular Biology", 8th Edition, Lippincott Williams & Wilkins, New York, USA, 2001. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Gardner, E.J, Simmons, M.J, and Snustad, D.P., "Principles of Genetics",8th Edition, John Wiley & Sons, Singapore, 1991. | | | | | | | |
| 2. | Strickberger, M.W., "Genetics", 3rd Edition, Prentice Hall of India, New Delhi, 2008. | | | | | | | |
| 3. | Klug, W.S. and Cummings, M.R., "Concepts of Genetics", Pearson Education, New Delhi, 2003. | | | | | | | |

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td colspan="2">Department</td><td>Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Semester III</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT 312</td><td>BIOCHEMISTRY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="6">At the end of the course, the students would have gained extensive knowledge in Metabolic Pathways. This will be helpful for courses like, Bioinformatics, Protein Engineering and Enzyme Engineering and etc.</td></tr>
<tr><td>1</td><td colspan="5">CARBOHYDREATE METABOLISM</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Carbohydrates - General introduction, Classification: Monosaccharides, disaccharides, polysaccharides, properties of carbohydrate, metabolism of carbohydrates : Glycolysis, TCA cycle, Biosynthesis and degradation of starch and glycogen, gluconeogenesis.</td></tr>
<tr><td>2</td><td colspan="5">LIPID METABOLISM</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Lipids - General introduction, Classification: Simple, Compound and derived lipids, properties of various lipids, fatty acids; Biosynthesis of fatty acids, degradation of fatty acids, Biosynthesis of cholesterol and Trsioacyl glycerol. Metabolism of lipids and fatty acids.</td></tr>
<tr><td>3</td><td colspan="5">PROTEIN METABOLISM</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Proteins - General introduction, Classification based on of source, shape and composition, properties of various proteins, transamination, transdeamination oxidative decarboxylation, urea cycle, molecules derived from amino acids: biosynthesis of neurotransmitters. (dopamine, epinephrine and nor epinephrine)</td></tr>
<tr><td>4</td><td colspan="5">NUCLEIC ACID METABOLISM</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Nucleic acids - General introduction, Nucleosides, Nucleotides, and Types: DNA, RNA, Properties of Nucleic acids; Denaturation and Renaturation, Biosynthesis of nucleotides (de novo and salvage pathway degradation of nucleotides). Metabolism of Nucleosides and Nucleotides.</td></tr>
<tr><td>5</td><td colspan="5">ENZYMES AND BIOENERGETICS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Enzymes - General introduction, Nomenclature and classification, characteristics of enzymes, 3D structure of enzyme (lysozyme). Bioenergetics ATP synthase, electron carriers, electron transport complexes, oxidative phosphorylation, uncauplers and lonophores.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="3">45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="7">Jain J.L., “Fundamentals of Biochemistry” , S. Chand & Company Ltd., New Delhi, India, 2004.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Leinnger, L., “Principles of Biochemistry”, 6th edition, Nelson & Fox Maxwell Publication Pvt. Ltd., New York, USA, 2003.</td></tr>
<tr><td>2.</td><td colspan="7">Lubert Stryer, “Biochemistry”, 4th Edition, W. H. Freeman and Co., New York, USA, 2002.</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology | | | | | |

## Semester III

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 313 | BIOORGANIC CHEMISTRY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course the students would have gained in depth knowledge in Stereochemistry, Stereochemistry of enzyme reactions and Protein folding. This knowledge will be very helpful for learning other subjects in subsequent semesters. | | | | | | | |

| | | | |
|---|---|---|---|
| 1 | CONCEPTS IN BIOORGANIC CHEMISTRY | Total Hrs | 9 |

Transition state theory- Hammond postulate, Principle of catalysis- acid, base catalysis, covalent catalysis- Electrophilic and nucleophilic catalysis. Structure – activity relationships. Principle of microscopic reversibility and kinetic isotopic effects- primary, secondary, multiple, and solvent isotopic effects.

| | | | |
|---|---|---|---|
| 2 | STEREOCHEMISTRY IN BIOORGANIC CHEMISTRY | Total Hrs | 9 |

Optical activity and chirality, Stereochemistry of enzymatic and non enzymatic reactions – $NAD^+$ and $NADP^+$ -dependent oxidation and reduction reactions, hydration reactions, inversion of configuration at chiral centers, chiral methyl group and chiral phosphate.

| | | | |
|---|---|---|---|
| 3 | CASE STUDIES OF ENZYME STRUCTURE AND MECHANISM | Total Hrs | 9 |

Dehydrogenases, Proteases, Ribonucleases, lysozyme, Zymogens –types, mechanism of action, active site structure, site – site interaction, enzyme substrate complex structure.

| | | | |
|---|---|---|---|
| 4 | PROTEIN STABILITY AND PROTEIN FOLDING | Total Hrs | 9 |

Thermodymnamics of protein folding, acid – base induced denaturation of proteins, structure of denatured state, measurement of changes in stability, energetic of formation of structure, kinetics of protein folding- two state and multistate kinetics, transition state in protein folding, $^1H$ /$^2H$ exchange methods.

| | | | |
|---|---|---|---|
| 5 | FOLDING PATHWAYS & ENERGY LANDSCAPES | Total Hrs | 9 |

Levinthal's paradox, folding of ci2, nucleation - condensation mechanism, folding of barnase, folding pathway of barstar at microsecond resolution, unifield folding scheme, insights from theory, optimization of folding rates, molecular chaperones.

| | |
|---|---|
| Total hours to be taught | 45 |

Text book (s) :

| | |
|---|---|
| 1 | Alan Fersht, "Structure and Mechanism in Protein Science: A Guide To Enzyme Catalysis and Protein Folding", Sixth Printing, W.H. Freeman and Company, New York, USA, 1999. |

Reference(s) :

| | |
|---|---|
| 1 | Voet, D. and Voet, G., "Biochemistry", 3rd Edition, John Wiley & Sons, Singapore, 2001. |
| 2 | Dugas, H., "Bioorganic Chemistry", Springer Verlag, London, U.K. 1999. |

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<tr><td colspan="6">K.S.Rangasamy College of Technology Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
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<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 314</td><td colspan="2">INDUSTRIAL MICROBIOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">At the end of the course the students would have learnt about all types of microorganisms, their growth characteristics and their industrial uses. This will be very helpful to students when they undertake project work in Biotechnology.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION TO INDUSTRIAL MICROBIOLOGY</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">History and development of industrial Microbiology-contribution of Anton von Leeuwenhoek, Louis Pasteur, Alexander Fleming, Selman and Waksman. Role of microscope in identification of microorganisms-Light microscope, Dark field microscope, Phase contrast microscope. Staining methods- Gram’s staining, Capsule staining and fungal staining.</td></tr>
<tr><td>2</td><td colspan="4">BACTERIAL STRUCTURE AND TAXONOMY</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Whittaker’s five kingdom system concept. Classification systems- Phenetic, Numerical, Phylogenetic. Major characteristics used in taxonomy. Bergey’s Manual of Determinative Bacteriology. Bacterial structure, cell wall, cell membrane, capsule, flagella and sporulation.</td></tr>
<tr><td>3</td><td colspan="4">MICROBIAL NUTRITION AND GROWTH</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Nutritional requirements of bacteria –Carbon, Nitrogen, Phosphorus, Sulphur. Nutritional classification of bacteria. Different media used for bacterial culture; growth curve, growth kinetics, Influence of environmental factors on growth. Measurement of microbial growth - Cell mass and cell numbers.</td></tr>
<tr><td>4</td><td colspan="4">MEDIA FORMULATION AND OPTIMIZATION</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Formulation of media for industrial fermentation. Screening of industrial important microorganisms. Preservation of microbes. Sterilization and sanitation process - Physical methods - Dry heat, Moist heat, Filtration, Pasteurization, Radiation- Chemical methods.</td></tr>
<tr><td>5</td><td colspan="4">INDUSTRIAL APPLICATION</td><td colspan="2">Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Primary metabolites and secondary metabolites and their applications; Industrial production of Streptomycin; Citric acid, Glutamic acid, Vitamin B12 and Steroid biotransformation. Role of microorganisms in Industrial effluent treatment – Microorganisms and pollution control.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="8">Prescott, L.M., Harley, J.P. and Klein, D.A., “Microbiology”, 6th Edition, TATA McGraw-Hill Publications, New Delhi, India, 2010.</td></tr>
<tr><td>2.</td><td colspan="8">Pelczar, M.J., Chan, E.C.S. and Krieg, M.R., “Microbiology: An application Based Approach”. TATA McGraw-Hill Publications, New Delhi, India, 2005.</td></tr>
<tr><td>3.</td><td colspan="8">Crueger, W. and Crueger, A., “Biotechnology: A text book of Industrial Microbiology”. 2nd Edition, Panima Publishing Corporation, New Delhi, India, 2004.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="8">Black, J.G., “Microbiology: Principles and Explorations”. 6th Edition. John Wiley and Sons, Inc, Singapore, 2004.</td></tr>
<tr><td>2.</td><td colspan="8">Kamal, Rao, G.P. and Modi, D.R., “Concepts of Microbiology”. International Book Distributing Co., Lucknow, India, 2005.</td></tr>
</table>

<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Semester III</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 315</td><td colspan="2">PRINCIPLES OF CHEMICAL ENGINEERING</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">At the end of the course the students would have gained knowledge in Mass and Energy Conservation, Laws of Thermodynamics and Principles of Fluid Mechanics. This will help him to understand certain subjects of Engineering offered in this programme.</td></tr>
<tr><td>1</td><td colspan="4">FUNDAMENTAL CONCEPT AND MATERIAL BALANCES</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Concept of unit operations and unit processes; units and conversions; basic laws; Material balance: basic steps in individual and overall material balances; simple material balance calculations with and without chemical reactions.</td></tr>
<tr><td>2</td><td colspan="4">ENERGY BALANCES</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Basic steps in energy balance; considerations for reacting systems; heat of reaction at constant pressure and constant volume; effect of temperature and pressure on heat of reaction; simple energy balance calculations across a piece of equipment.</td></tr>
<tr><td>3</td><td colspan="4">MECHANICAL OPERATIONS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Laws of size reduction; differential and cumulative size analysis; storage of solids-bin, silo, hopper; size reduction equipment – ball mill. Jaw crusher, roll crusher, hammer mill.</td></tr>
<tr><td>4</td><td colspan="4">FLOW OF FLUIDS</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Nature of fluid; classification of fluids; concept of viscosity; fluid motion and viscosity profile; laminar and turbulent flow; concept of boundary layers; equation of continuity ; fluid head; total energy balance for steady flow; mechanical energy balance-Bernoulli’s equation ; frictional losses in laminar flow-Hagen poisulle equation.</td></tr>
<tr><td>5</td><td colspan="4">FLUID TRANSPORT, FLOW THROUGH FLUIDIZED AND PACKED BED</td><td colspan="2">Total Hrs</td><td>12</td></tr>
<tr><td colspan="8">Types of pumps-centrifugal, reciprocating , rotary pumps; concept of cavitation; priming; NPSH; water hammering ;flow through porous media-pressure drop calculations, Ergun equation, kozeny clasius equation, bueke-plummer equation, Fluidization principle; types; minimum fluidization and settling velocity.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>60</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="7">Salil K ghosal, Shyamal K sanyal, Siddhartha Datta, “Introduction to Chemical Engineering”, TATA McGraw-Hill Publication, New Delhi, 1993.</td></tr>
<tr><td>2.</td><td colspan="7">McCabe, W.L., Smith, J.C, Harriot, P., “Unit Operations In Chemical Engineering”, 5th Edition, McGraw-Hill Inc., New Delhi, 1993.</td></tr>
<tr><td>3.</td><td colspan="7">Bhatt, B.I., Vora S.M., “Stoichiometry”, 3rd Edition, Tata McGraw-Hill Publication, New Delhi, 1977.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Geankoplis C.J., “Transport Processes and Unit Operations”, Prentice Hall India, New Delhi, 2002.</td></tr>
<tr><td>2.</td><td colspan="7">Gavhane K.A., ”Introduction to Process Calculation”, Nirali prakashan Publication, New Delhi, 2008.</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 3P1 | BIOCHEMISTRY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective (s) | Educate the theoretical concepts Experimentally | | | | | | | |

(Any ten experiments)

| | |
|---|---|
| 1 | Qualitative analysis of carbohydrates and amino acids (Tyr and Trp) |
| 2 | Estimation of sugars by Nelsson's somogy; method |
| 3 | Estimation of A/G ratio by Biuret method |
| 4 | Estimation of cholesterol by Zalics method |
| 5 | Estimation of creatinine by Jaff's method. |
| 6 | Estimation of urea by Dam method |
| 7 | Estimation of uric acid by Caraway's method |
| 8 | Isolation and estimation of glycogen by Anthrone's method. |
| 9 | Isolation and estimation of fructose from banana by Seliwanoff's method |
| 10 | Estimation of phosphorus by Fisky and Subbarow method. |
| 11 | Estimation of lipids by Folch *et al*., method |
| 12 | Estimation of microelements by Flame meter method |
| Total hours to be taught | 45 |

Lab Manual :


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

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Bio Technology | Program code & Name | BT : B.Tech Biotechnology | | | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 3P2 | BIOORGANIC CHEMISTRY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of this laboratory course, the students would have learnt about spectroscopy, nephelometry & chromatography. In addition the student will also gain knowledge of operating these equipments. | | | | | | | |

(Any eight experiments)

| | |
|---|---|
| 1. | Synthesis of Aspirin |
| 2. | Estimation of Vitamin C by DCPIP method |
| 3. | Estimation of inorganic Phosphate by Fiske and Subbaraw method |
| 4. | Preparation of oleic acid from Tartaric acid |
| 5. | Preparation of alpha d- glucopyranose pentaacetate |
| 6. | Isolation of lycopene from tomato paste |
| 7. | Preparation of l-cysteine from hair |
| 8. | Cellulase degradation by Acid Hydrolysis |
| 9. | Isolation of Albumin from Egg |
| 10. | Isolation and characterization of casein from milk |

| | |
|---|---|
| Total hours to be taught | 45 |

Lab Manual :

| | |
|---|---|
| 1. | Wilson, K. and Walker, J., "Practical Biochemistry", 5th Edition, Cambridge University Press, Cambridge, UK, 2003. |

| K.S.Rangasamy College of Technology Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 3P3 | INDUSTRIAL MICROBIOLOGY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | To learn about the culturing of microorganism, their identification by hands on training. Moreover, water and milk samples are to be tested under lab condition to find out the contamination. | | | | | | | |

(Any 10 experiments)

| | |
|---|---|
| 1. | Preparation of culture media –Liquid and Solid media |
| 2. | Pure culture techniques- Pour plate, Streak plate, Spread plate |
| 3. | Staining techniques – Gram's staining and Fungal staining |
| 4. | Isolation of enzyme producing microorganisms from soil |
| 5. | Physiological characteristics of microorganisms- Starch hydrolysis test |
| 6. | Carbohydrate fermentation test |
| 7. | IMViC Test |
| 8. | Casein hydrolysis test |
| 9. | Water quality analysis –Most Probable Number test (MPN) |
| 10. | Methylene Blue Reduction Test - MBRT |
| 11. | Antibiotic sensitivity test |
| 12 | Growth curve- Turbidity method |

| | |
|---|---|
| Total hours to be taught | 45 |

Text Book :

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

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester III** | | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | | |
| | | L | T | P | C | CA | ES | Total | |
| 10 TP 0P1 | Career Competency Development I | 0 | 0 | 2 | 0 | 100 | 00 | 100 | |
| Objective(s) | To enhance employability skills and to develop career competency | | | | | | | | |

| Unit – 1 | Written Communication – Part 1 | Hrs |
|---|---|---|
| Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition - Change of Voice - Change of Speech - Synonyms & Antonyms - One Word Substitution - Using the Same Word as Different Parts of Speech - Odd Man Out - Spelling & Punctuation (Editing)<br>Materials: Instructor Manual, Word Power Made Easy Book | | 8 |
| Unit – 2 | Written Communication – Part 2 | |
| Analogies - Sentence Formation - Sentence Completion - Sentence Correction - idioms & Phrases - Jumbled Sentences, Letter Drafting (Formal Letters) - Reading Comprehension(Level 1) - Contextual Usage - Foreign Language Words used in English<br>Materials: Instructor Manual, Word Power Made Easy Book | | 8 |
| Unit – 3 | Oral Communication – Part 1 | |
| Self Introduction - Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations- Prepared -'Just A Minute' Sessions (JAM)<br>Materials: Instructor Manual, News Papers | | 4 |
| Unit – 4 | Oral Communication – Part 2 | |
| Describing Objects / Situations / People, Information Transfer - Picture Talk - News Paper and Book Review<br>Materials: Instructor Manual, News Papers | | 4 |
| Unit – 5 | Speed Maths, Quantitative Aptitude | |
| Think Without Ink(TWI) Approach - Speed Maths: Squaring of Numbers - Multiplication of Numbers - Finding Square Roots - Finding Cube Roots - Solving Simultaneous Equations Faster - Number System: HCF, LCM - Decimals - Percentages - Averages - Powers and Roots - Sudoku (level 1) - Series Completion (Numbers, Alphabets, Pictures) - Odd Man Out - Puzzles<br>Materials: Instructor Manual, Aptitude Book | | 6 |
| | Total | 30 |

Evaluation Criteria

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

Reference Books

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

Note :

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

## III Semester Course Outcomes

| Modules | 10 MA 003 - ENGINEERING MATHEMATICS III<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Form partial differential equations of different types. |
| 2. | Solve partial differential equations of different types and methods. |
| 3. | Understand the basic concepts of Fourier series. |
| 4. | Express the functions of different types as a Fourier series. |
| 5. | Classify the second order partial differential equations. |
| 6. | Remember the fundamentals of wave, heat functions and the procedure to find the solution of wave and heat equations. |
| 7. | Remember the basic concepts of Fourier transform. |
| 8. | Find the Fourier transform for the functions of different types. |
| 9. | Remember the fundamentals of Z-transform and inverse Z-transform. |
| 10. | Solve the difference equations of different types using Z-transform and inverse Z-transform. |

| Modules | 10 BT 311 - CELL BIOLOGY AND GENETICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Distiguish the structure and molecular organization of plant and animal cells. |
| 2. | State the importance and characteristic features of chromosome. |
| 3. | Discriminate the components and molecular models of cell membrane. |
| 4. | Illustrate the principle and mechanism behind cell cycle. |
| 5. | Outline the Mendel's principles . |
| 6. | Calculate the sex linkage among different group of people by pedigree analysis. |
| 7. | Annotate the morphological changes due to the variation of chromosome number. |
| 8. | Criticize the process of mutagenesis. |
| 9. | Analyse the population by Hardy – Weinberg equilibrium. |
| 10. | Deduce the variations and evolutionary aspects of population genetics. |

| Modules | 10 BT 312 – BIOCHEMISTRY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe carbohydrates, their classification and properties. |
| 2. | Illustrate the metabolism of carbohydrates |
| 3. | Categorize the types of lipids and fatty acids and their properties. |
| 4. | Understand the pathways for metabolism of fatty acids and biosynthesis of cholesterol. |
| 5. | Classify the types of proteins based on their shape and composition along with their properties. |
| 6. | Outline the various metabolic processes that involve proteins and amino acids. |
| 7. | Determine the structures, properties and types of nucleic acids |
| 8. | Describe the de novo and salvage pathways in biosynthesis of nucleic acids |
| 9. | Characterize 3D structure of enzymes, their classification and nomenclature. |
| 10. | Describe the functional role of enzymes in bioenergetics. |

| Modules | 10 BT 313-BIOORGANIC CHEMISTRY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Define transition state theory and determine free energy of activation with kinetic isotope effects. |
| 2. | Understand the features of catalyst influencing in the enzyme function. |
| 3. | Compare and contrast the stereochemistry of enzymatic and non-enzymatic reactions. |
| 4. | Explain the mechanism of inversion of chiral organic molecules. |
| 5. | Comprehend the step by step activity of amino acids in the active site of the enzymes. |
| 6. | Define enzyme catalyzed reactions and interpret the function of enzyme substrate complex. |
| 7. | Illustrate the thermodynamics of protein folding and its changes. |
| 8. | Predict the kinetics of protein folding during 1H/2H exchange methods. |
| 9. | Compile the pathways of protein folding . |
| 10. | Illustrate the mechanism of molecular chaperons and the folding rate optimization. |

| Modules | 10 BT 314 – INDUSTRIAL MICROBIOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Outline the basics of light microscopes and its types. |
| 2. | Propose the development of industrial microbiology and contribution by various microbiologists. |
| 3. | Classify and characterize the bacteria based on Bergey's manual and Whittaker's concept. |
| 4. | Generalize the structure of prokaryotes and their functions. |
| 5. | Know the nutritional requirements of diverse media for culturing bacteria. |
| 6. | Elucidate growth curve and growth kinetics of microbes. |
| 7. | Recommend the formulation of media in fermentation and screening of industrially important microbes. |
| 8. | Deliver the processes involved in sterilization, preservation and sanitation of microbes. |
| 9. | Illustrate the applications of primary and secondary metabolites in the production of organic and inorganic compounds. |
| 10. | Prioritize Bioremediation |

| Modules | 10 BT 315 -PRINCIPLES OF CHEMICAL ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Reproduce the basics of material balance with and without chemical reactions. |
| 2. | Relate the dimensions and quantification of industrial processes |
| 3. | Develop the basic steps in energy balance and their considerations. |
| 4. | Analyse the effect of temperature and pressure on heat energy requirement in industries through energy balance. |
| 5. | Dramatize the size reduction equipment to meet the industrial requirements. |
| 6. | Calculate the energy expenditure as per laws of size reduction and analyze the storage requirement of products. |
| 7. | Validate the classification and characteristics of fluids. |
| 8. | Understand the basic concept of mechanical energy balance and frictional losses in laminar flow. |
| 9. | Analyze the types and performance of pumps such as centrifugal, reciprocating and rotary pumps. |
| 10. | Design packed and fluidized reactors based on pressure drop calculations, minimum fluidization and settling velocity. |

| Modules | 10 BT 3P1-BIOCHEMISTRY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Elucidate the fundamental analysis of carbohydrates qualitatively. |
| 2. | Determine the quantitative analysis of sugars using Nelsson Somogy method. |
| 3. | Describe the major views to calculate the amount of lipids by Folch *et al*., method. |
| 4. | Estimate the amount of cholesterol and interpret the results using Zalics method |
| 5. | Interpret the amount of creatinine present in the sample using Jaffe method. |
| 6. | Apply the methodology implemented using DAM method to estimate the amount of urea in the given sample. |
| 7. | Predict and interpret the results by estimating the amount of uric acid using Caraway method. |
| 8. | Extract and estimate the amount of fructose from banana. |
| 9. | Quantify the level of phosphorus in blood sample of patients and interpret the results. |
| 10. | Analyze the amount of microelements in soil sample using Flame photometer. |

| Modules | 10 BT 3P2- BIOORGANIC CHEMISTRY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | **At the end of the course, the student will be able to** |
| 1. | Demonstrate the process and principle behind the Synthesis of Aspirin by chemical synthesis |
| 2. | Estimate the quantity of Vitamin C by DCPIP method and illustrate the principle behind the titration |
| 3. | Investigate the quantity of inorganic phosphate present in the unknown sample by Fiske and Subbarow method |
| 4. | Analyse the quantity of oleic acid prepared from olive oil and exemplify the principle behind the process |
| 5. | Interpret the principle behind the preparation of alpha d- glucopyranose penta acetate using zinc chloride |
| 6. | Observe and quantify the pigment lycopene which is isolated from tomato paste |
| 7. | Describe the process and principle behind the preparation of l-cysteine from hair |
| 8. | Illustrate the principle behind Cellulose degradation by Acid Hydrolysis |
| 9. | Isolate and characterize albumin from Egg by salting in method |
| 10. | Investigate the process of isolation and characterization of casein from milk |

| Modules | 10 BT 3P3 -INDUSTRIAL MICROBIOLOGY LABORATORY<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the steps involve in developing a medium for culturing microbes. |
| 2. | Demonstrate the basic steps involved in pure culture techniques. |
| 3. | Interpret the different types of staining techniques for identification of microbes |
| 4. | Outline the process of isolation of microorganisms from soil capable of producing enzymes |
| 5. | Analysis of starch hydrolysis for physiological identification of microorganisms. |
| 6. | Adapt biochemical characterization for identification microbes through IMViC and Casein hydrolysis test |
| 7. | Illustrate the water quality analysis through Most Probable Number test |
| 8. | Examine the milk quality through Methylene Blue Reduction Test |
| 9. | Demonstrate the antibiotic sensitivity test for the selected pathogens |
| 10. | Illustrate the different growth phase of microorganisms through turbidity method |

| Modules | 10 TP 0P1 - Career Competency Development I<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate aptitude skills on basic level |
| 2. | Write programs using c language |
| 3. | Construct sentences in english and make correction |
| 4. | Perform oral communication for a shorter period |
| 5. | Prepare and present technical paper |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester IV** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 MA 004 | PROBABILITY AND STATISTICS (BT, IT, ME, TT) | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the students would Acquire skills in handling situations involving more than one random variable and functions of random variables. Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems. Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation. | | | | | | | |
| 1 | PROBABILITY AND RANDOM VARIABLE | | | | Total Hrs | 12 | | |
| Axioms of probability - Conditional probability - Total probability - Bayes theorem - Random variable - Probability mass function - Probability density functions - Properties- Moments - Moment generating functions and their properties. | | | | | | | | |
| 2 | STANDARD DISTRIBUTIONS | | | | Total Hrs | 12 | | |
| Binomial, Poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties. | | | | | | | | |
| 3 | TWO DIMENSIONAL RANDOM VARIABLES | | | | Total Hrs | 12 | | |
| Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression - Transformation of random variables - Central limit theorem. | | | | | | | | |
| 4 | TESTING OF HYPOTHESIS | | | | Total Hrs | 12 | | |
| Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit. | | | | | | | | |
| 5 | DESIGN OF EXPERIMENTS | | | | Total Hrs | 12 | | |
| Analysis of variance – One way classification – Completely Randomized block Design - Two – way classification – Randomized Block Design - Latin square. | | | | | | | | |
| Total hours to be taught | | | | | | 60 | | |
| Text book (s) : | | | | | | | | |
| 1 | Gupta, S.C, and Kapur, J.N., “Fundamentals of Mathematical Statistics”, Sultan Chand, Ninth edition, New Delhi, 1996. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Ross. S., “A first Course in Probability”, Fifth Edition, Pearson Education, Delhi 2002. | | | | | | | |
| 2 | Johnson. R. A., “Miller & Freund’s Probability and Statistics for Engineers”, Sixth Edition, Pearson Education, Delhi, 2000. | | | | | | | |
| 3 | Lipschutz. S and Schiller. J, “Schaum’s outlines - Introduction to Probability and Statistics”, McGraw-Hill, New Delhi, 1998. | | | | | | | |
| 4 | Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, “Probability and Statistics for Engineers and Scientists”, Seventh Edition, Pearsons Education, Delhi, 2002. | | | | | | | |
| 5 | Johnson. R. A., “Miller & Freund’s Probability and Statistics for Engineers”, Sixth Edition, Pearson Education, Delhi, 2000. (Chapters 7, 8, 9, 12). | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester IV** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 411 | MOLECULAR BIOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course the students would have learnt about the structure of Nucleic acid, DNA replication and how the expression is regulated. This Knowledge will be very useful for students to study specialized subjects in Modern biology & Biotechnology. | | | | | | | |
| 1 | OVERVIEW OF MOLECULAR BIOLOGY | | | | Total Hrs | 9 | | |
| DNA and RNA as the Genetic material, Griffith experiment, Hershey and Chase experiment, Avery Mc Cleod and Mc Carthy experiments. Bacterial Transformation, Conjugation and Transduction. Confirmation of DNA and RNA molecules. | | | | | | | | |
| 2 | STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION | | | | Total Hrs | 9 | | |
| Replication in Prokaryotes and Eukaryotes. Enzymology of DNA Replication, Mechanism and events in Replication. Replication models and types, D-loop, Rolling circle mode of replication. Phage replication. Replication of linear viral DNA. Organization of Eukaryotic genome – cot value .Repair of DNA. | | | | | | | | |
| 3 | TRANSCRIPTION | | | | Total Hrs | 9 | | |
| Prokaryotic and Eukaryotic Transcription, RNA polymerase, Transcription signals, transcription factors, Features of promoters and enhancers, ribozymes. Mechanism of transcription, Post transcriptional modification. Capping, Adenylation, Splicing. Processing of rRNA and tRNA, RNA editing. | | | | | | | | |
| 4 | TRANSLATION | | | | Total Hrs | 10 | | |
| Genetic code, Protein synthesis mechanism. Prokaryotic and Eukaryotic translation- initiation, elongation and termination of Protein synthesis. Inhibitors of Translation. Post translational modification-Glycosylation, Phosphorylation and Sulfation. Protein targeting. | | | | | | | | |
| 5 | REGULATION OF GENE EXPRESSION | | | | Total Hrs | 8 | | |
| Operon Concept. Negative Control (Lac Operon), Positive control (Arabinose operon), Tryptophan Operon. Method of studying gene expression. Reporter genes, DNA microarray technique, Serial analysis of gene expression, SAGE annotated down sized extract, FISH. | | | | | | | | |
| Total Hours Taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1. | David Frifelder, “Molecular Biology”, Narosa Publication House, New Delhi, India, 1999. | | | | | | | |
| 2. | Benjamin Lewin, “Gene IX”, Oxford University Press, New Delhi, India, 2000. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Watson, J.D., Hopkins, W.H., Roberts, J. W., Steitz, J.A. and Weiner, A.M., “Molecular Biology of the Gene”, The Benjamin / Cummings Publication Company, California, USA. 1987. | | | | | | | |
| 2. | Old, B., Richard, M.T. and Primrose, S. B., “Principles of Gene Manipulation: An introduction to Genetic Engineering”, Black Well Science Publication, Malden, USA. 2001. | | | | | | | |

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td colspan="2">Department</td><td>Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester IV</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT 412</td><td>INDUSTRIAL BIOTECHNOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">At the end of the course, the students would have learnt about the production of primary & secondary metabolites, enzymes and single cell proteins on an industrial scale. This will be very useful for entrepreneurship.</td></tr>
<tr><td>1.</td><td colspan="5">INDUSTRIAL FERMENTATION</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Screening of new metabolites, Primary and Secondary metabolites strain development for metabolite production, substrates used for industrial fermentation; Carbon and Nitrogen sources, Methods of fermentation, batch and continuous fermentation, Different fermentation systems, Different stages of fermentation process.</td></tr>
<tr><td>2.</td><td colspan="5">PRODUCT RECOVERY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Different unit operations in product recovery, product purification, yield coefficient, Organisms feed stocks produced by fermentation, Biosynthesis of ethanol, acetone/ butanol and glycerol. Organic acids (citric acid and acetic acid) production and utilization.</td></tr>
<tr><td>3.</td><td colspan="5">PRODUCTION OF SECONDARY METABOLITES</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Commercial production and application of amino acids (L-glutamic acid, L-lysine and L-tryptophan). Enzyme production and their applications in large scale level: amylase, glucose isomerase, protease, lipase, penicillin acylase and lactase. Production of vitamins and antibiotics (Penicillin, Cephalosporins and Tetracyclin).</td></tr>
<tr><td>4.</td><td colspan="5">PRODUCTION OF BIOPRODUCTS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Large scale production and applications of microbial Pesticides, Fungicides, Biofertilizers, Biopolimers, Biopreservation, Single cell proteins, Mushroom cultivation, Production of Ergot alkaloids, Microbial transformations, Bioconversion of steroid and Non-steroid compounds.</td></tr>
<tr><td>5.</td><td colspan="5">MODERN BIOTECHNOLOGY PRODUCTS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Newer approaches to sewage treatment, treatment process, Biogas: methane production, Role of microorganisms in leaching and mining, Biosynthesis of growth hormones. Extracellular polysaccharides, Fermented foods, Alcoholic beverages (beer and wine).</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="8">Cruger, W. and Crueger, A.," Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi, 2004.</td></tr>
<tr><td>2.</td><td colspan="8">Casida, L.E., "Industrial Microbiology", New Age International (P) Ltd. New Delhi, 2001.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="8">Murrey Moo and Young, D., "Comprehensive Biotechnology", Pergamon, New Delhi, 2001.</td></tr>
<tr><td>2.</td><td colspan="8">Presscott, D., "Industrial Microbiology", CBS Publishers, New Delhi, 1999.</td></tr>
<tr><td>3.</td><td colspan="8">Sathyanarayana, U., "Biotechnology", Books and Allied (P) Ltd, Kolkatta, 1997.</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester IV** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 413 | INSTRUMENTATION TECHNIQUES | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the syllabus the students would have learnt about the working principles of optical methods, radioisotopes, spectroscopy and separation methods. This will facilitate the students to do the research work innovatively. | | | | | | | |
| 1 | ELECTROCHEMICAL AND CENTRIFUGATION TECHNIQUES | | | | Total Hrs | 9 | | |
| Measurement of pH and its significance – Definition, Buffers and pH control weak acid and weak acid equilibrium. Principle, operation and Glass electrode and pH measurements; Determination of pH by using the pH meter Centrifugation- Basic principles centrifuge and its applications in biological science –Types of centrifugation - Preparative, analytical, ultra centrifuge and its application and sedimentation, coefficient. | | | | | | | | |
| 2 | RADIOISOTOPES | | | | Total Hrs | 9 | | |
| Nature of Radioactivity- Types and principles of radioactive isotope, Decay and half life units of radioactivity, physical basics of instrumentation and measurement of radioactivity – Radiation and detectors and application – Autoradiography and Radioimmunoassay, Liquid scintillation counter, Tracer Techniques. | | | | | | | | |
| 3 | CHROMATOGRAPHIC TECHNIQUES | | | | Total Hrs | 13 | | |
| Definition, principle, performance parameters, retention, resolution, types of chromatography principles and application of Paper, Column, Affinity, Adsorption, Partition chromatography, TLC, ion exchange, GC and HPLC. Types of exchangers, DNA cellulose chromatography. | | | | | | | | |
| 4 | ELECTROPHORESIS | | | | Total Hrs | 9 | | |
| Physical basis of Electrophoresis, development, principles, types of moving boundary, gel starch, polyacrylamide, non-denaturing and denaturing, electro – blotting. 2D-SDS PAGE and iso electric focusing. Agaraose gel – applications in DNA analysis, capillary electrophoresis, PFGE, electrophoresis of RNA. | | | | | | | | |
| 5 | SPECTROSCOPIC TECHNIQUES | | | | Total Hrs | 9 | | |
| Measurement of transmittance and absorbance- Beer- Lambert's Law – nature of interaction of electromagestic radiation with molecular of elements – Transitions in spectroscopy. Physical basis and applications of atomic and molecular spectroscopy: Absorption (UV, Visible, IR, NMR and ESR) and emission (Fluorescence, phosphorescence and chemi-luminance) spectroscopy, Mass spectroscopy, Turbidimetry and Nephelometry. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1. | Upadhyay, A., Upadhyay, K. and Nath, N., "Biophysical Chemistry: Principles and Techniques", 4th Edition, Himalaya Publishing House, New Delhi, 2007. | | | | | | | |
| 2. | Wilson, K. and Walker, J., "Practical Biochemistry", 5th Edition, Cambridge University Press, Cambridge, UK, 2003. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Willard, H. H., Merritt, Jr. L., Dean, J. A. and Settle, Jr. F. A., "Instrumental Methods Analysis", 7th Edition, CBC Publishers and Distributors, New Delhi, 2007. | | | | | | | |
| 2. | Ewing, G.W., "Instrumental Methods of Chemistry Analysis", McGraw Hill Publication, New Delhi, 1989. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester IV

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 414 | CHEMICAL REACTION ENGINEERING | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the student would have learnt chemical kinetics, various types of reactors and how they function. This will help the student to take up PG course in Bioprocess, Biochemical engineering. And also the project work. | | | | | | | |

| | | | |
|---|---|---|---|
| 1. | SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING | Total Hrs | 12 |

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

| | | | |
|---|---|---|---|
| 2. | IDEAL REACTORS | Total Hrs | 12 |

Ideal Reactors for a single Reaction, Design for a single Reaction, Multiple-reactor systems, Recycle reactor, Autocatalytic Reactions , Irreversible First-order Reactions in series, First-Order followed by Zero-order reactions, Reversible reactions semi-batch reactors, performance equation for single rectors; multiple reactor system; multiple reactions.

| | | | |
|---|---|---|---|
| 3. | FLOW AND NON IDEAL FLOW | Total Hrs | 12 |

Resistance time distribution in ideal flow; Non- ideal flow models; C,E and F curves; Dispersion Model, Tank in series Model, Reactor performance with non-ideal flow.

| | | | |
|---|---|---|---|
| 4. | CHEMICAL AND BIOCATALYTIC REACTORS | Total Hrs | 12 |

Catalytic reactions- types, properties of catalyst, catalytic reactors-types-packed bed reactor, slurry reactor, trickle bed reactor, fluidized bed reactor and raiser reactor: surface sand enzyme reaction rate; porous catalysis; performance reactor for catalytic bed reactor; heterogeneous catalysis.

| | | | |
|---|---|---|---|
| 5. | CHEMICAL REACTION EQUILIBRIA | Total Hrs | 12 |

Reaction stiochoimetry ; criteria of chemical equilibrium; equilibrium constant and standard free energy change; effect of temperature and pressure on equilibrium constant; other factor affecting equilibrium conversion; heterogeneous equilibria.

| | |
|---|---|
| Total hours to be taught | 60 |

Text book (s) :


| | |
|---|---|
| 1. | Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition. John Wiley and Sons, New Delhi, 1999. |
| 2. | Gavhane, K.A., “Chemical Reaction Engineering”, Vol I & Vol II, Nirali Prakashan Publisher, New Delhi, 2000. |
| 3 | Narayanan, K.V., “A Text Book of Chemical Engineering Thermodynamics”, Prentice Hall of India, New Delhi, 2002. |


Reference(s) :


| | |
|---|---|
| 1. | Smith, J.M., “Chemical Engineering Kinetics”, Third Edition, McGraw-Hill Publication, New Delhi, 1981. |
| 2 | Fogler, H.S., “Elements of Chemical Engineering”, Prentice Hall of India, New Delhi, 2002. |
| 3. | Missen, R.W., Mims, C.A. and Saviile, B.A., “Introduction to Chemical Engineering and Kinetics”, John Wiley and Sons, New Delhi, 1999. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester IV

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 415 | BIOCHEMICAL THERMODYNAMICS | 3 | 1 | 0 | 4 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the students would have learnt about thermodynamic properties of fluids, Chemical potential, fugacity, Gibbs-Duhem equation, Phase equilibria etc. The knowledge gained in this course will be very useful for studying certain specialized subjects offered in later semesters. |
|---|---|

| 1. | BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS. | Total Hrs | 12 |
|---|---|---|---|

System and processes; state and properties; state and path function; equilibrium concept and phase rule; Zero$^{th}$ law of thermodynamics; reversible and irreversible processes; Statement of first law of thermodynamics ; internal energy; enthalpy; first law applicable to flow and non-flow process. Heat capacity.

| 2. | P-V-T BEHAVIOUR AND SECOND LAW THERMODYNAMICS. | Total Hrs | 12 |
|---|---|---|---|

P-V-T behaviour of pure fluids; concept of ideal gas- constant volume , temperature; adiabatic and polytrophic process; equation of state for real gases- viral equation, vandaar walls equation, redilich-wang;statement of second law; carnot theorem ; thermodynamic temperature scale; entropy;clausis-inequality; mathematical statement of second law; calculation of entropy changes; third law of thermodymics.

| 3. | REFRIGERATION AND LIQUEFACTION. | Total Hrs | 12 |
|---|---|---|---|

COP and refrigerator capacity ; carnot refrigerator; choice of refrigerant ; types of refrigeration process-vapour compression system, air refrigeration and absorption refrigeration system, heat pump; general methods for liquefaction of gases; liquefaction through vapourisation of liquid; joule- Thomson expansion; Linde and Claude liquefaction.

| 4. | PROPERTIES OF BIOSOLUTIONS. | Total Hrs | 12 |
|---|---|---|---|

Partial molar properties ; concept of chemical potential ; fugacity; activity; fugacity co-efficient and activity
co-efficient; applicability of the solutions- Lewis Randall rule, Gibbs duhem equation; property changes of
mixing in fermenters; heat effects of mixing in biological broths

| 5. | PHASE EQUILIBRIA. | Total Hrs | 12 |
|---|---|---|---|

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

| Total hours to be taught | 60 |
|---|---|

Text book (s) :

| 1. | Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, New Delhi, 2002. |
|---|---|

Reference(s) :

| 1. | Smith, J.M., Van Ness, H.C. and Abbot, M.M., "Chemical Engineering Thermodynamics", 6$^{th}$ Edition McGraw-Hill Publications, New Delhi, 2001. |
|---|---|
| 2. | Gopinath Halder., "Introduction to Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd. New Delhi, 2009. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester IV

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 4P1 | MOLECULAR BIOLOGY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of this course, the students would have learnt basic techniques used in Molecular Biology and its application. This will be strength for students to undertake research projects in the area of molecular biology | | | | | | | |

( Any seven experiments)

| | |
|---|---|
| 1. | Agarose gel electrophoresis techniques |
| 2. | Extraction of plasmid DNA from bacterial cells |
| 3. | Extraction of genomic DNA from bacterial cells |
| 4. | Extraction of genomic DNA from yeast cells |
| 5. | Extraction of genomic DNA from plants by CTAB method |
| 6. | Extraction of genomic DNA from animal cells by high salt method |
| 7. | Extraction of total RNA from prokaryotes |
| 8. | Extraction of DNA from Agarose gel |
| 9. | Titration of phage concentration |

| | |
|---|---|
| Total hours to be taught | 45 |

References :


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

<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Semester IV</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 4P2</td><td>INSTRUMENTATION TECHNIQUES LABORATORY</td><td>0</td><td>0</td><td>3</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">At the end of this laboratory course, the students would have learnt about spectroscopy, nephelometry and chromatography. In addition the student will also gain knowledge of operating procedures of these equipments.</td></tr>
<tr><td colspan="8">(Any 10 experiments)</td></tr>
<tr><td>1.</td><td colspan="7">Precision and validity in an experiment using absorption spectroscopy.</td></tr>
<tr><td>2.</td><td colspan="7">Validating Lambert-Beer’s law using kmno4</td></tr>
<tr><td>3.</td><td colspan="7">Extraction of bioactive compounds from plant leaves using Soxhelt apparatus</td></tr>
<tr><td>4.</td><td colspan="7">Preservation of microbial cultures using Lyophilizer</td></tr>
<tr><td>5.</td><td colspan="7">Estimation of different nucleic acids (DNA and RNA) using plant leaves.</td></tr>
<tr><td>6.</td><td colspan="7">Cell disruption using sonication method</td></tr>
<tr><td>7.</td><td colspan="7">Estimation of SO-4 by Nephelometry.</td></tr>
<tr><td>8.</td><td colspan="7">Estimation of AL3+ by Flourimetry</td></tr>
<tr><td>9.</td><td colspan="7">Separation of pigments using Column chromatography</td></tr>
<tr><td>10.</td><td colspan="7">Chromatography analysis using TLC.</td></tr>
<tr><td>11.</td><td colspan="7">Estimation of ethanol using Gas chromatography.</td></tr>
<tr><td>12.</td><td colspan="7">Estimation of trace elements by Flame photometry.</td></tr>
<tr><td colspan="6">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="8">Lab Manual :</td></tr>
<tr><td>1.</td><td colspan="7">Upadhaya, K., Upadhaya, A. and Nath, N., “Biophysical Chemistry”, Himalaya Publishing House, New Delhi, India, 2007.</td></tr>
</table>

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester IV</td></tr>
<tr><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 4P3</td><td colspan="2">CHEMICAL AND REACTION ENGINEERING LABORATORY</td><td>0</td><td>0</td><td>3</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">At the end of the course, the student would have learnt about Performance characteristic of reactor procedures and how to perform them. This will be very useful for specialized project work that the students undertake in the subsequent semesters.</td></tr>
<tr><td colspan="9">(Any 10 experiments)</td></tr>
<tr><td>1.</td><td colspan="8">Performance and Kinetic studies of batch reactor.</td></tr>
<tr><td>2.</td><td colspan="8">Performance and Kinetic studies of semi batch reactor.</td></tr>
<tr><td>3.</td><td colspan="8">Performance characteristic of mixed flow reactor.</td></tr>
<tr><td>4.</td><td colspan="8">Performance characteristic of plug flow reactor</td></tr>
<tr><td>5.</td><td colspan="8">RTD studies in Continuous reactor.</td></tr>
<tr><td>6.</td><td colspan="8">Friction factor studies in flow pipes.</td></tr>
<tr><td>7.</td><td colspan="8">Studies on Flow through Packed Column.</td></tr>
<tr><td>8.</td><td colspan="8">Studies on Flow through fluidized Column.</td></tr>
<tr><td>9.</td><td colspan="8">Studies on Jaw and Roll Crusher</td></tr>
<tr><td>10.</td><td colspan="8">Studies on Filtrations</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="9">Reference :</td></tr>
<tr><td>1.</td><td colspan="8">Pauline M. Doran, “Bioprocess Engineering Principles”, Academic Press, New York, USA. 2003.</td></tr>
<tr><td>2.</td><td colspan="8">Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition, John Wiley, Singapore, 1999.</td></tr>
</table>

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology | | | | | |
| Semester IV | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 TP 0P2 | Career Competency Development II | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| Objective(s) | To enhance employability skills and to develop career competency | | | | | | | |

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

Evaluation Criteria

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

Reference Books


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


Note :

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

## IV Semester Course Outcome

| Modules | 10 MA 004 - Probability and Statistics<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Remember the basic concepts, fundamentals and the axioms of Probability |
| 2. | Determine the probability density function, probability mass function, cumulative distribution function, expected value, variance, standard deviation |
| 3. | Remember the basics of discrete and continuous distributions |
| 4. | Apply the concepts of discrete and continuous distributions in solving the problems. |
| 5. | Calculate the Covariance, Correlation and the Regression |
| 6. | Define the Characteristic function of a distribution and to apply the Central Limit Theorem |
| 7. | Define the principles of Testing of hypothesis, conduct the hypothesis testing to different samples means, sample proportions and the sample variances. |
| 8. | Perform and analyze hypothesis tests of means, proportions and variances, apply the appropriate Chi-Squared test for independence and goodness of fit. |
| 9. | Design, conduct experiments, analyze and interpret data. |
| 10. | Apply Analysis of Variance to One-way classification, Completely randomized design, Two-way classification, Randomized block design and the Latin square |

| Modules | 10 BT 411 MOLECULAR BIOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Draw the structure of DNA and RNA and demonstrate the experiments that prove the DNA and RNA as the genetic material |
| 2. | Discuss and differentiate the methods of gene transfer in prokaryotes |
| 3. | Differentiate the mechanism of replication in prokaryotes and eukaryotes . |
| 4. | Discriminate the different models of replication and DNA repair mechanism |
| 5. | Generalize promoter, enhancers, activators and its role in transcription. |
| 6. | Describe the process of post transcriptional modification |
| 7. | Apply Wobble hypothesis to write the genetic code for translation process . |
| 8. | Explain mechanism and regulation of prokaryotic and eukaryotic translation , events of post-translational modification and protein sorting in eukaryotes. |
| 9. | Distiguish the positive and negative regulation of gene expression |
| 10. | Implement DNA microarray, SAGE, FISH techniques in project work |

| Modules | 10 BT 412 - INDUSTRIAL BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the basic concepts of industrial fermentation technology |
| 2. | Differentiate the various types of fermentation systems. |
| 3. | Determine the unit operation involved in product recovery and purification process. |
| 4. | Learn the biosynthesis pathway for the production and utilization of organic compounds. |
| 5. | Investigate the commercial importance of metabolites and enzymes. |
| 6. | Characterize the concept for the production of vitamins and antibiotics |
| 7. | Apply the processing techniques for the large scale production of commercial bioproducts. |
| 8. | Determine the concept of microbial transformation and bioconversion of steroid and non-steroid compounds |
| 9. | Outline the applications of modern biotechnological process. |
| 10. | Illustrate the importance of commercially fermented food and alcoholic beverages. |

| Modules | 10 BT 413- INSTRUMENTATION TECHNIQUES<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate the different types of measurement of pH |
| 2. | Classify and delineate the various types of centrifuges |
| 3. | Describe the principle behind radioactivity and the types of radioisotopes |
| 4. | Determine the methods involved in the measurement of radioactivity |
| 5. | Define the basic principle behind the chromatographic separation of biomolecules. |
| 6. | Categorize the types of chromatographic separations |
| 7. | Outline the physical basis and types of electrophoresis |
| 8. | Illustrate the importance of electrophoresis and blotting techniques |
| 9. | Measure transmittance and absorbance by Beer Lambert's law and its importance |
| 10. | Describe the basics of absorption and emission based spectroscopic techniques |

| Modules | 10BT414-CHEMICAL REACTION ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Outline chemical reactors, concentration and temperature dependence of rate equation. |
| 2. | Derive the kinetics of irreversible uni molecular type first order and bimolecular type second order reactions. |
| 3. | Develop the performance equation of recycle and semi batch reactors for single and multiple reactions. |
| 4. | Determine fractional conversion and final concentration achieved in single and multiple reactor systems. |
| 5. | Construct tank-in-series model by calculating number of tanks needed to achieve desired conversion. |
| 6. | Analyze non-ideality in flow reactors by dispersion model. |
| 7. | Calculate reaction rate for heterogeneous catalysis and enzyme catalyzed reactions. |
| 8. | Develop performance equation for multiphase reactors. |
| 9. | Represent general stoichiometry of a chemical reaction and characterize standard free energy change of reaction. |
| 10. | Analyze the factors affecting equilibrium constant and equilibrium conversion in heterogeneous reactions. |

| Modules | 10 BT 415 - BIOCHEMICAL THERMODYNAMICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Apply the laws of thermodynamic to solve the energy related issues. |
| 2. | Determine the flow and non-flow analysis in reversible and irreversible processes to deal true energy requirements. |
| 3. | Define a model for pressure – volume - temperature behavior of various fluids in industrial level based on equations of state. |
| 4. | Obtain the novel methodology that can be applied by various equations and theorems to attain the energy needs. |
| 5. | Understand the various types of refrigerant, refrigeration processes and coefficient of performance of refrigeration system. |
| 6. | Analyze the various parameters for the efficiency and process modernization in liquefaction using joule-thompson and linde concepts. |
| 7. | Apply partial molar properties of industrial process fluids and their applicability in solution thermodynamics such as fugacity, activity and activity coefficient. |
| 8. | Analyze the molar properties of solutions using lewis randall rule, gibbs duhem theorems for the design of bioreactors with respect to heat energy utilization. |
| 9. | Design the multi-phase process operation to enhance the productivity through equilibrium stability using duhem's theorem. |
| 10. | Implement the novel methods to solve the operating issues especially for the vapour-liquid equilibria applicable to multi-component systems. |

| Modules | 10 BT 4P1 - MOLECULAR BIOLOGY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Handle various instruments used in molecular biology laboratory and also to troubleshoot it. |
| 2. | Perform the steps to isolate the genomic dna, plasmid dna, total rna from bacteria. |
| 3. | Perform the steps to isolate the genomic dna from different sources like bacteria, fungi, plant and blood. |
| 4. | Prepare and perform agarose gel, interpret the data obtained from the agarose gel using graphical, uv spectrophotometric |
| 5. | Excise and elute out the dna from the agarose gel using column and silica based methods |
| 6. | Analyze and interpret the result of phage titration by counting the plaque forming unit |

| Modules | 10 BT 4P2 - INSTRUMENTATION TECHNIQUES LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Use absorption spectroscopy to obtain valid and precise results in qualitative analysis experiments and validate lambert-beer's law using $kmno_4$ |
| 2. | Extract bioactive compounds from plant leaves using soxhelt apparatus method |
| 3. | Infer the principle and methodology of preserving microbial cultures using lyophilizer |
| 4. | Estimate the concentration of different nucleic acids (dna and rna) from plant leaves |
| 5. | Demonstrate the principle and methodology behind cell disruption by sonication method |
| 6. | Estimate the concentration of so4 – in an unknown sample by nephelometry method |
| 7. | Estimate the concentration of al3+ in the given sample by flourimetry method |
| 8. | Describe the principle and process of pigments separation using column chromatography method and thin layer chromatography method |
| 9. | Analyse the concentration of ethanol in various samples using gas chromatography method |
| 10. | Estimate the quantity of trace elements by flame photometry method and understand its principle |

| Modules | 10 BT 4P3 - CHEMICAL REACTION ENGINEERING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate batch reactor by carrying out second order reactions with equimolar quantities of reactants |
| 2. | Calculate fractional conversion of reactant achieved in semi batch reactor. |
| 3. | Analyze the kinetics of first order reactions in mixed flow reactor. |
| 4. | Design plug flow reactor to calculate conversion and exit concentration. |
| 5. | Perform experiment to account non-ideality in continuous stirred tank reactor. |
| 6. | Conduct experiment to find friction factor for flow through straight copper and galvanized pipes. |
| 7. | Calculate pressure drop per unit length of packed column using erguns equation. |
| 8. | Estimate minimum fluidization velocity and assess type of flow in fluidization column. |
| 9. | Calculate resistances offered by filter medium and filter cake in plate and frame filter press. |
| 10. | Characterize mean particle size by differential and cumulative analysis of fraction obtained from jaw crusher by sieve analysis. |

| Modules | 10 TP 0P2 - Career Competency Development II<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate their aptitude and reasoning skills |
| 2. | Enhance their verbal ability and written ability |
| 3. | Express their programming skills in data structure |
| 4. | Perform in group discussion |
| 5. | Reveal their technical knowledge |

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="3">Programme Code & Name</td><td colspan="3">BT: B.Tech. Biotechnology</td></tr>
<tr><td colspan="9">Semester V</td></tr>
<tr><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 511</td><td colspan="2">FOOD BIOTECHNOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">At the end of the course, the student would have gained knowledge in various aspects of Food processing and its importance for industrial applications. This will facilitate the students to take up higher studies in the area of Food technology and to become an entrepreneur.</td></tr>
<tr><td>1</td><td colspan="5">PRINCIPLES OF FOOD PROCESSING</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Aim of Food Science and Technology, Principles and methods of food preservation: Use of high temperature, evaporation and drying, refrigeration and cold storage, irradiation, food additives, food colours and flavours.</td></tr>
<tr><td>2</td><td colspan="5">TYPES OF FOOD PROCESSING</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Technology of milk and milk products - processing of market milk: Types of milk products: Cheese, Yoghurt, Ice cream, Vegetables and Fruits processing technology – Jam, jelly, marmalade, pickles and fruit beverages. Processing of meat and meat products. Baking technology: Bread, Cake and Biscuit preparation.</td></tr>
<tr><td>3</td><td colspan="5">FOOD ENGINEERING OPERATIONS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Characteristics of raw materials, preparative operations – cleaning, sorting and grading of foods. Food conversion operations – Technological aspects of industrial production of alcoholic beverages: beer, wine, distilled liquors, Production of fats and oils, Applications of enzymes in food processing industry.</td></tr>
<tr><td>4</td><td colspan="5">FOOD MICROBIOLOGY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Growth and survival of microorganisms in foods, factors influencing the growth of microbes, Microbial cultures used in food industries, Microorganisms as food: probiotics and prebiotics, mycoproteins, food spoilage, food borne illness: Infection and intoxication.</td></tr>
<tr><td>5</td><td colspan="5">FOOD QUALITY AND MANAGEMENT</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Sensory evaluation of food quality: appearance, textural, flavour factors, consumer safety, Organizations dealing with inspection, Certification and quality assurance, Food safety standards: WHO, FPO, FAO, MMPO, HACCP, GMP; Food adulteration.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Sivasankar, B. “Food Processing and Preservation” Sixth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, India, 2009.</td></tr>
<tr><td>2</td><td colspan="8">Frazier, W.C., Westhoff, D.C., “Food Microbiology” fourth Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi. India, 2008.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">James M .Jay, “Modern Food Microbiology” Fourth Edition, CBS Publishing Company Ltd., New Delhi, India, 2005.</td></tr>
</table>

| K.S.Rangasamy College of Technology Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT: B.Tech. Biotechnology | | | |
| **Semester V** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 512 | GENETIC ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To develop skills of the students in the area of Genetic Engineering. This will be a pre-requisite for electives like Genomics, Proteomics and the student would learn about various aspects of Genetic Engineering and its application. This will be of very useful for the students to undertake research / project work in Genetic Engineering. | | | | | | | |

| 1 | FUNDAMENTAL TECHNIQUES OF GENE MANIPULATION | Total Hrs | 9 |
|---|---|---|---|

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

| 2 | BIOLOGY OF CLONING VECTORS | Total Hrs | 9 |
|---|---|---|---|

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

| 3 | GENE CLONING STRATEGIES AND SCREENING | Total Hrs | 9 |
|---|---|---|---|

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

| 4 | TECHNIQUES IN GENETIC ENGINEERING | Total Hrs | 9 |
|---|---|---|---|

PCR: Mechanism, Types, Taqman assay, Molecular beacons, RAPD, RFLP, Site directed mutagenesis: primer extension -Strand selection-Cassette mutagenesis-PCR based, Methods of nucleic acid sequencing: Sanger's method, Maxam and Gilbert and Automated sequencing method.

| 5 | APPLICATIONS OF rDNA TECHNOLOGY | Total Hrs | 9 |
|---|---|---|---|

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

| Total Hours Taught | 45 |
|---|---|

Text book (s) :


| 1 | Primrose S.B. and Twyman R. M.,"Principles of gene manipulation and Genomics", 7th Edition, Blackwell Publishing, Malden, US, 2001. |
|---|---|
| 2 | Richard J. Reece., "Analysis of Genes and Genomes", John Wiley and Sons Ltd., Singapore, 2004. |


Reference(s) :


| 1 | Winnacker, E.L. From Genes to Clones, Introduction to Gene Technology, Panima Educational Book Agency, New Delhi. India, 1987. |
|---|---|
| 2 | Glick, B.R., and Pasternak, J.F., "Molecular Biotechnology. Principles and applications in recombinant DNA", ASM Press, Washington, US. 1998. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | | Programme Code & Name | | | | | | BT: B.Tech. Biotechnology |
| **Semester V** | | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | | |
| | | L | T | P | C | CA | ES | Total | |
| 10 BT 513 | BIOINFORMATICS | 3 | 1 | 0 | 4 | 50 | 50 | 100 | |
| Objective(s) | To develop interdisplinary skills in the application of computers in biotechnology and learn about the biological databases, in silico tools and machine learning techniques | | | | | | | | |
| 1 | INTRODUCTION TO BIOINFORMATICS | | | | Total Hrs | 12 | | | |
| Definition, scope of Bioinformatics, Use of computers in prediction of structure of RNA, DNA and protein, Search engines, Search algorithms, Characteristics and categories of biological databases. | | | | | | | | | |
| 2 | BIOLOGICAL DATABASES | | | | Total Hrs | 12 | | | |
| Databases in Molecular Biology: PubMed, primary, Sequencing databases: DNA and protein, Genbank, Swissprot, Derived databases. Pfam, BLOCKS. Structural databases: PUBCHEM. PDB, SCOP and CATH. | | | | | | | | | |
| 3 | PATTERN MATCHING | | | | Total Hrs | 12 | | | |
| Pairwise sequence alignment: dot matrix analysis, Local Vs global alignment; Substitution matrices: PAM and BLOSUM, Dynamic programming: Needleman Wunch and Smith waterman algorithm; BLAST, FASTA; Multiple sequence alignment. | | | | | | | | | |
| 4 | MACHINE LEARNING AND PHYLOGENY | | | | Total Hrs | 12 | | | |
| Neural networks, Statistical methods, Hidden Markov model; Gene prediction algorithm: methods of gene prediction, Gene prediction tools, Phylogenetic analysis: Distance based method; Character based method, methods of evaluating phylogenies: Boot Strapping. | | | | | | | | | |
| 5 | APPLICATION OF BIOINFORMATICS | | | | Total Hrs | 12 | | | |
| Methods of RNA structure prediction; Protein structure prediction: 2D and 3D structure; Microarray data analysis; Drug designing, Quantitative structure activity relationship; Molecular docking. | | | | | | | | | |
| Total hours to be taught | | | | | | 60 | | | |
| Text book (s) : | | | | | | | | | |
| 1 | Rastogi, S.C., “Bioinformatics – Concepts, skills and applications”, CBS Publishers and Distributors, New Delhi, India, 2003. | | | | | | | | |
| 2 | Bergeron, B., “Bioinformatics Computing”, Prentice Hall of India, New Delhi, India, 2002. | | | | | | | | |
| Reference(s) : | | | | | | | | | |
| 1 | Gibas, C. and Jambeck, P., “Developing Bioinformatics Skills’’, O’Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US, 1999. | | | | | | | | |
| 2 | David W. Mount., “Bioinformatics Sequence and Genome Analysis”, 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US, 2004. | | | | | | | | |
| 3 | Attwood, T.K and Parry Smith, D.J., “Introduction to Bioinformatics”, Pearson Education Asia, New Delhi, India, 2001. | | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous | | | R 2010 |
|---|---|---|---|
| Regulation | | | |
| Department | Biotechnology | Program code & Name | BT: B.Tech. Biotechnology |

## Semester V

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 514 | PROTEIN ENGINEERING | 3 | 0 | 0 | 0 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the student would have learnt structure and function of proteins of particular importance; the student will know the production of recombinant insulin and the students get knowledge about the importance of engineered proteins applied in therapeutics. |
|---|---|

| 1 | AMINO ACIDS AND PROTEINS | Total Hrs | 9 |
|---|---|---|---|

Classification of amino acids and their molecular properties (size, solubility, charge and pKa value), Chemical relativity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol and imidazole groups), Classification of protein and their molecular properties.

| 2 | BONDS AND ENGINEERING IN PROTEIN MAKE-UP | Total Hrs | 9 |
|---|---|---|---|

Different bonds in protein formation: Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions, Elucidation of protein structure by X-ray crystallography, NMR, ESR and MALDI-TOF.

| 3 | PROTEIN ARCHITECTURE | Total Hrs | 9 |
|---|---|---|---|

Primary structure: peptide mapping, peptide sequencing; automated Edman degradation, High throughput protein sequencing; Secondary structure: Alpha, Beta and loop structures; Super secondary structure, topology diagrams, Prediction of substrate binding sites, Ramachandran plot; Tertiary structure: Domains, protein folding, Overview of 3D structures, Quaternary structure: Molecular nature, formation of complexes.

| 4 | STRUCTURE-FUNCTIONAL RELATIONSHIP | Total Hrs | 9 |
|---|---|---|---|

DNA-binding proteins; Eukaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Zinc finger proteins, Leucine zipper proteins, Membrane proteins: Trans membrane segments, bacteriorhodopsin and photosynthetic reaction center.

| 5 | APPLICATIONS OF PROTEIN ENGINEERING | Total Hrs | 9 |
|---|---|---|---|

Recombinant insulin to reduce aggregation and inactivation, *de novo* protein design, Protein databases. Structural similarities, Molecular modelling, Protein - protein interactions, Peptide vaccines, Protein modifications, SNPs.

| Total Hours to be taught | 45 |
|---|---|

Text Book(s) :


1. Voet, D. and Voet, G., “Biochemistry”, Third Edition, John Wiley and Sons, Singapore, 2001.
2. Branden, C. and Tooze, J., “Introduction to Protein structure”, Second Edition, Garland Publishing, New York, US, 1999.


Reference(s) :


1. Creighton, T.E., “Proteins”, Second Edition, Freeman WH, US, 1993.
2. Moody, P.C.E. and Wilkinson, A.J., “Protein Engineering”, IRL Press, Oxford, UK, 1990.

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT: B.Tech. Biotechnology | | | |
| **Semester V** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 515 | ENZYME ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course the student would have learnt about enzymes, their mode of action, Kinetics of enzyme action and techniques like enzyme immobilization, purification of enzymes & Biosensors. This knowledge gained through this course will be helpful to carry out project work in the field of Enzyme engineering. | | | | | | | |

| | | | |
|---|---|---|---|
| 1 | INTRODUCTION TO ENZYMES | Total Hrs | 9 |
| Classification and nomenclature of enzymes. General properties of enzymes. Mechanism of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, Transition state theory. | | | |
| 2 | ENZYME KINETICS | Total Hrs | 9 |
| Kinetics of single substrate reactions: Michelis – Menten parameters, Lineweaver Burk plot, Turnover number, Kinetics of multi substrate reactions: mechanisms, ping-pong, random order, compulsory order, steady state kinetics. Types of enzyme inhibition, and Allosteric inhibition. Binding of ligands to proteins: Hill equation and adair equation. Sigmoidal kinetics: Monod Changeux Wyman model. | | | |
| 3 | PURIFICATION AND CHARACTERIZATION OF ENZYMES | Total Hrs | 9 |
| Production and purification of crude enzyme extracts from plants, animals and microbial sources; methods of characterization of enzymes; development of enzymatic assays. Production of recombinant enzymes: serine protease, lysozyme. | | | |
| 4 | ENZYME IMMOBILIZATION | Total Hrs | 9 |
| Physical and chemical technique for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding. Advantages and disadvantages of immobilized enzymes. Effect of biotic and abiotic factors on enzyme immobilization. | | | |
| 5 | INDUSTRIAL APPLICATIONS OF ENZYMES | Total Hrs | 9 |
| Application of enzymes in food industry, medicine, environmental; design of enzyme electrodes and their applications, forensic science, Biotechnological applications of enzymes: synthesis of artificial enzymes. | | | |
| Total Hours to be taught | | | 45 |

Text Book(s ):


1. Palmer, T. and Bonner, P., "Enzymes: Biochemistry, Biotechnology and Clinical chemistry", Affiliated East – West Press Pvt. Ltd., New Delhi, India, 2008.
2. Voet, D. and Voet, G., "Biochemistry", Third Edition, John Wiley and Sons, Singapore, 2001.


Reference(s) :


1. James, E. Bailey and David F. Ollis, "Biochemical Engineering Fundamentals", 2nd Edition. McGraw Hill, New Delhi. India, 1986.
2. Nicholas, Price, C. and Lewis Stevens, "Fundamentals of Enzymology", Oxford University Press Publication, New Delhi, India, 2001.

<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Semester V</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 516</td><td>BIOPROCESS ENGINEERING AND TECHNOLOGY</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">At the end of the course, the students would have learnt about fermentation process, Cell Disruption Methods and Purification processes. This will serve as an effective course to understand bioseparation process in detail.</td></tr>
<tr><td>1</td><td colspan="4">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Introduction to Bioprocessing: Historical development of Bioprocess technology, An overview of traditional and modern applications of Biotechnological processes. Interdisciplinary approach, Unit operations and Down stream processing in Bioprocessing.</td></tr>
<tr><td>2</td><td colspan="4">FERMENTATION PROCESSES</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Techniques of enzyme immobilization by Bioprocessing Engineering, General requirements and types of fermentation processes, aerobic and anaerobic fermentation process, Medium requirements for fermentation processes; various commercial media for industrial fermentation; Sterilization of air, media and fermenters.</td></tr>
<tr><td>3</td><td colspan="4">PROCESS DESIGN AND OPERATION OF BIOREACTORS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Bioreactor design and construction - ancillaries design of ideal reactors: single and multiple reactors, types of bioreactors: batch, continuous and fed- batch, operational modes of Bioreactors, bioprocess design considerations for plant and animal cell culture.</td></tr>
<tr><td>4</td><td colspan="4">RHEOLOGY OF FERMENTATION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Rheology and mixing of fermentation broth, Newtonian and Non Newtonian fluids, Mass transfer in bioprocessing operation, Types of mass transfer operations, Heat transfer in Bioprocesssing operations.</td></tr>
<tr><td>5</td><td colspan="4">PRODUCT RECOVERY</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Bioproduct recovery process: Filtration, sedimentation, centrifugation, precipitation, cell disruption, chromatography, crystallization, lyophilization and drying. Effluent treatments by various methods.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Rao, D. G., “Introduction to Biochemical Engineering”, Second Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, India, 2010.</td></tr>
<tr><td>2.</td><td colspan="7">Stanbury, F.P., Whitaker, A. and Hall, S.G., “Principles of Fermentation Technology”, Aditya Books, Pvt. Ltd., New Delhi, India, 1997.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Belter, P.A. and Cussler, E., “Bioseparations”, Wiley – Interscience Publication, Canada, 1988.</td></tr>
<tr><td>2.</td><td colspan="7">Shuler,M.L. and Kargi, F.,” Bioprocess Engineering Basic Concepts”, Prentice Hall of India, Pvt. Ltd., New Delhi, India, 2003.</td></tr>
<tr><td>3.</td><td colspan="7">Bailey, J. and Ollis, David F., “Fundamentals of Biochemical Engineering”, Tata McGraw Hill, New Delhi, India, 1986.</td></tr>
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| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
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| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester V

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 5P1 | GENETIC ENGINEERING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of this Laboratory, the students would have learnt basic techniques applied in Genetic Engineering. | | | | | | | |

( 9 experiments)

| S.No. | Name of the Experiments |
|---|---|
| 1 | Plasmid DNA extraction |
| 2 | Restriction Enzyme Digestion of Vector |
| 3 | Partial digestion of genomic DNA |
| 4 | Ligation of restricted vector and genomic DNA |
| 5 | Competent cell preparation- Calcium Chloride method |
| 6 | Transformation by heat-shock induction method |
| 7 | Screening and selection of recombinants |
| 8 | PCR- 16S rDNA amplification |
| 9 | RAPD |
| 10 | RFLP |
| 11 | Southern Transfer Technique |
| 12 | Separation of Proteins by SDS – PAGE method |

| Total hours to be taught | 45 |
|---|---|

Lab Manual :


| 1. | Sambrook, J. and Russsel, D.W. “Molecular cloning – A laboratory manual”, Third Edition, Cold Spring Harbor Laboratory Press, Cold Spring harbor, New York, USA. 2001. |
|---|---|

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester V

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 5P2 | BIOPROCESS ENGINEERING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of the laboratory the students would have learn the technology in Bioprocess engineering and its applications in detail. | | | | | | | |

( 8 experiments)

| S.No. | Name of the Experiments |
|---|---|
| 1. | Media Optimization – Plackett Burman design |
| 2. | Determination of Kla value by gassing out method |
| 3. | Evaluation of parameters on Monod model for growth of microorganism |
| 4. | Thermal Death Kinetics of microorganisms |
| 5. | Batch Sterilization |
| 6. | Determination of Kla by sodium sulpide oxidation method |
| 7. | Determination of yield coefficient of yeast on glucose |
| 8. | Growth kinetics of fungi |

| Total hours to be taught | 45 |
|---|---|

Lab Manual :

| | |
|---|---|
| 1. | Ponmurugan. P., Nithya Ramasubramanian and M. Fredimoses., “Experimental Procedures in Bioprocess Technology and Downstream Processing”, Anjanaa Book House, Chennai, India, 2012. |

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|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester V

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 5P3 | PROTEIN AND ENZYME ENGINEERING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of the laboratory the students would have learn the technology in Enzyme engineering and its various applications in detail. | | | | | | | |

( 11 Experiments)

| S.No. | Name of the Experiments |
|---|---|
| 1. | Estimation of protein by Lowry *et al*. (1951) method |
| 2. | Enzyme Assay - Protease |
| 3. | Effect of different pH on Acid phosphatase activity |
| 4. | Effect of different temperature on Acid phosphatase activity - Arrhenius plot |
| 5. | Enzyme Kinetics - Effect of different substrates on Acid phosphatase activity |
| 6. | Enzyme Kinetics - Effect of inducers on Acid phosphatase activity |
| 7. | Enzyme Kinetics - Effect of inhibitors on Acid phosphatase activity |
| 8. | Production and estimation of amylase |
| 9. | Enzyme immobilization - Gel entrapment by sodium alginate |
| 10. | Native PAGE |
| 11. | Western Blotting |

| Total hours to be taught | 45 |
|---|---|

Lab Manual :

| | |
|---|---|
| 1. | Talwar, G.P., Gupta, S.K. A Handbook of Practical and Immunology. CBS Publishers & Distributors, New Delhi. India, 2004. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | | | Programme Code & Name | | BT : B.Tech Biotechnology | | |
| **Semester V** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 TP 0P3 | Career Competency Development III | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| Objective(s) | To enhance employability skills and to develop career competency | | | | | | | |

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

Evaluation Criteria

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

Reference Books


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


Note :

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

| Modules | 10 BT 511- FOOD BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the basic concepts of food processing technology and quality improvement. |
| 2. | Differentiate the various types of heat and cold processing methods. |
| 3. | infer the concept of dairy, fruits, vegetable, bakery and meat technology |
| 4. | know the processing techniques of commercially important and value added products such as cheese, bread, ice cream, jam and cakes |
| 5. | Investigate the importance of preparative, food conversion operation and the equipments related to food processing industries. |
| 6. | Interpret the concept of sorting and grading of foods and role of enzymes in food processing industries. |
| 7. | learn the basics of food microbiology and food spoilage |
| 8. | Delineate the research focusing area such as probiotication in food industry. |
| 9. | determine the concept of sensory evaluation responsible for food safety |
| 10. | Describe the types and regulation of national and international agencies responsible for food quality control |

| Modules | 10 BT 512 -GENETIC ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Define and describe restriction enzymes and their role in genetic engineering |
| 2. | Illustrate the various types of blotting techniques in genetic engineering |
| 3. | Characterize the cloning vectors used in manipulation of genes |
| 4. | Describe the artificial chromosomes used in genetic manipulation studies |
| 5. | Deduce the strategies involved in gene cloning |
| 6. | Outline the methods involved in screening of cloned genes |
| 7. | Illustrate PCR based techniques involved in genetic manipulation |
| 8. | Describe the methods involved in nucleic acid sequencing |
| 9. | Comprehend the applications of rDNA technology |
| 10. | Discuss the production of molecules and list the safety guidelines for recombinant DNA technology |

| odules | 10 BT 513- BIOINFORMATICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Know the basic concepts of bioinformatics and searching process. |
| 2. | Describe the primitive concepts of biological database and its nomenclature. |
| 3. | Demonstrate the objectives of primary databases, secondary databases and different sequence formats. |
| 4. | Annotate the need of protein structural database and their significance. |
| 5. | Characterize the optimal alignment of sequences either by local or global algorithm. |
| 6. | Describe the BLAST and FASTA algorithms and their applications in similarity search. |
| 7. | Describe and deduce soft computing algorithms that are applied in gene prediction and in protein structure patterns. |
| 8. | Classify the phylogenetic analysis for evolutionary tree and its validation methods. |
| 9. | Categorize the protein and RNA structure prediction algorithms. |
| 10. | Characterize the gene expression using Microarray images and various steps involved in drug designing. |

| Modules | 10 BT 514 -PROTEIN ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the classification and nomenclature of enzymes and their properties |
| 2. | Outline the mechanism and specificity of enzyme action along the principles of catalysis |
| 3. | Describe the kinetics of single substrate and multi substrate reactions, m-m kinetics, ping-pong mechanism etc., |
| 4. | Describe types of enzyme inhibition, hill equation and MWC model |
| 5. | Explain the production and purification process of enzymes from plants and animal sources. |
| 6. | Illustrate the characterization methods of enzymes and recombinant enzymes |
| 7. | Discuss the physical and chemical techniques of enzyme immobilization such as adsorption, encapsulation etc., |
| 8. | Outline the effect of biotic and abiotic factors on enzyme immobilization |
| 9. | Validate the application of enzymes in industries like food and health. |
| 10. | Discuss the application of enzymes as enzyme electrodes and their biotechnological applications |

| Modules | 10 BT 515- ENZYME ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the classification and nomenclature of enzymes and their properties |
| 2. | Outline the mechanism and specificity of enzyme action along the principles of catalysis |
| 3. | Describe the kinetics of single substrate and multi substrate reactions, m-m kinetics, ping-pong mechanism etc., |
| 4. | Describe types of enzyme inhibition, hill equation and MWC model |
| 5. | Explain the production and purification process of enzymes from plants and animal sources. |
| 6. | Illustrate the characterization methods of enzymes and recombinant enzymes |
| 7. | Discuss the physical and chemical techniques of enzyme immobilization such as adsorption, encapsulation etc., |
| 8. | Outline the effect of biotic and abiotic factors on enzyme immobilization |
| 9. | Validate the application of enzymes in industries like food and health. |
| 10. | Discuss the application of enzymes as enzyme electrodes and their biotechnological applications |

| Modules | 10 BT 516- BIOPROCESS ENGINEERING AND TECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the historical development of bioprocess technology, traditional and modern applications of biotechnological process. |
| 2. | Description of various unit operations and downstream processing in bioprocessing. |
| 3. | Design, production and applications of techniques involved in enzyme immobilization by bioprocess Engineering. |
| 4. | Formulate the various commercial media for industrial fermentations and design operations of fermenters. |
| 5. | Construction of ancillaries design of ideal reactors and various types of bioreactors. |
| 6. | Validate the design and operation mode of Bioreactor for plant and animal cell culture productions. |
| 7. | Study of mathematical principles in rheology and mixing of fermentation broth. |
| 8. | Interpret the heat and mass transfer in bioprocessing operations. |
| 9. | Describe the different bio product recovery process |
| 10. | Deduce the effluent treatment by various methods to protect from harmful effects of untreated effluents to society. |

| Modules | 10 BT 5P1 - GENETIC ENGINEERING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | isolate the plasmid DNA and select the correct restriction enzymes to digest the vector DNA that give cohesive ends . |
| 2. | mix the components of restriction digestion reaction and optimize the incubation time to partially digest the chromosomal DNA |
| 3. | mix-up the reaction components for ligating the restricted samples using T4 DNA ligase to produce recombinant DNA |
| 4. | make the E.coli DH5α cells competent using calcium chloride mediated method and perform the transformation experiment through heat shock induction method<br>screen and select the transformed cells using antibiotic and blue-white selection method |
| 5. | mix the reaction components of PCR at appropriate concentration and operate the thermocycler to amplify the DNA<br>select the correct oligo primer, optimize the reaction condition to perform RAPD and draw the phylogenetic tree using bioinformatics tool. |
| 6. | select the suitable enzyme, optimize the reaction condition to perform RAPD and draw the phylogenetic tree using bioinformatics tool.<br>perform the steps involved in the transfer of DNA from agarose gel to the nylon membrane through Southern transfer technique<br>assemble the plates to cast the polyacrylamide gel without any leakage and separate the protein sample through SDS-PAGE method |

| Modules | 10 BT 5P2 - BIOPROCESS ENGINEERING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | optimize the given media by placket burman method. |
| 2. | evaluate and design the media by placket burman method. |
| 3. | determine the KLa value by gassing out method. |
| 4. | illustrate the factors responsible for microorganisms to produce high yield bioproducts. |
| 5. | analyze the growth curve of microorganisms to predict sterilization. |
| 6. | detect and analyze the morphological appearance of microorganisms to study sterilization. |
| 7. | determine the thermal death kinetics of microorganisms by batch sterilization method. |
| 8. | relate and identify the efficient method for the batch sterilization. |
| 9. | operate the biofermentor for the determination of KLa by sodium sulphite oxidation method. |
| 10. | determine the yield coefficient of yeast on glucose. |

| Modules | 10 BT 5P3 - PROTEIN AND ENZYME ENGINEERING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Analyze the concentration of given unknown protein and infer the result. |
| 2. | Assess the protease enzyme quantity from the given bacterial culture. |
| 3. | Identify the optimum pH of alkaline phosphatase activity. |
| 4. | Demonstrate the role of temperature in enzyme activity. |
| 5. | Determine the suitable substrate and optimum concentration for alkaline phosphatase enzyme activity. |
| 6. | Evaluate the effect of inducer on alkaline phosphatase enzyme activity. |
| 7. | Describe the effect of inhibitors on the modification of three dimensional structure of alkaline phosphatase enzyme. |
| 8. | Relate efficient method for the production of amylase enzyme and infer the result. |
| 9. | Deduce the immobilization types and discuss its applications. |
| 10. | Infer the protein banding pattern in the NATIVE PAGE. |

| Modules | 10 TP 0P3 - Career Competency Development III<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Review the aptitude skills on data analysis |
| 2. | Organize, justify and conclude on the given information |
| 3. | Develop programs in object oriented programming concept |
| 4. | Interact on the recent topics |
| 5. | Appraise their technical knowledge and interpersonal skills |

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester VI</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 HS 001</td><td colspan="2">PROFESSIONAL ETHICS</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To create an awareness on Ethics and Human Values and instill Moral and Social Values in Students.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Ethics defined – Engineering as a profession – Core qualities of professional practitioners – Theories of right action – Major ethical issues – Three types of inquiry – Kohlberg's stages of moral development – Carol Gilligan theory – Moral dilemmas – Moral autonomy – Value based ethics.</td></tr>
<tr><td>2</td><td colspan="5">ENGINEERING AS SOCIAL EXPERIMENTATION</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Comparison with standard experiments – Relevant information – Learning from the past – Engineers as managers, consultants and leaders – Accountability – Role of codes – Code of ethics for engineers; introduction, rules of practice and professional obligations – The space shuttle challenger case study.</td></tr>
<tr><td>3</td><td colspan="5">ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK</td><td colspan="2">Total hrs</td><td>9</td></tr>
<tr><td colspan="9">Safety and Risk – Types of risks – Safety and the engineer – Designing for safety – Risk Benefit analysis – Accidents - The three mile Island disaster case study – The Chernobyl disaster case study.</td></tr>
<tr><td>4</td><td colspan="5">RESPONSIBILITIES AND RIGHTS</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Collegiality – Two senses of loyalty – Professional rights and responsibilities – Conflict of Interest – Collective Bargaining – Confidentiality – Acceptance of bribes / gifts – Occupational crimes – Whistle Blowing.</td></tr>
<tr><td>5</td><td colspan="5">GLOBAL ISSUES</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Globalization – Cross Cultural Issues – The Bhopal gas tragedy case study – Computer ethics – Weapons development – Intellectual property rights (IPR)</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="9">Text book(s) :</td></tr>
<tr><td>1</td><td colspan="8">Govindarajan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India (P) Ltd, New Delhi, 10th Reprint 2009.</td></tr>
<tr><td colspan="9">Reference(s):</td></tr>
<tr><td>1</td><td colspan="8">Mike W Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2007.</td></tr>
<tr><td>2</td><td colspan="8">Govindan, K.R., Sendhil Kumar, S., "Professional Ethics and Human Values", Anuradha Publications, Chennai, India, 2007.</td></tr>
</table>

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R2010 |
|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | BT : B.Tech Biotechnology |

## Semester VI

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 611 | PLANT BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | To develop the skills of the students in the area of Plant Biotechnology and its wide applications. To widen the knowledge about the production and applications of Transgenic plants and its uses. |
|---|---|

| 1 | INTRODUCTION TO PLANT TISSUE CULTURE | Total Hrs | 9 |
|---|---|---|---|

History of Plant tissue culture, preparation of Plant tissue culture media and Plant growth regulators, Sterilization of explants, Callus and suspension cultures, Micropropagation, meristem culture, organogenesis, regeneration of shoots and roots.

| 2 | ADVANCED PLANT TISSUE CULTURE | Total Hrs | 9 |
|---|---|---|---|

Embryo culture, Somatic embryogenesis, Synthetic seeds, Somaclonal variants, Haploid plant production: Anther, pollen, ovary culture, Protoplast culture, Somatic hybrids and Cybrids, Transfer and establishment of whole plants to greenhouse and field, Biochemical production of secondary metabolites using biofermenter, Germplasm conservation and Cryopreservation.

| 3 | PRODUCTION OF TRANSGENIC PLANTS | Total Hrs | 9 |
|---|---|---|---|

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

| 4 | TRANSGENIC PLANTS | Total Hrs | 9 |
|---|---|---|---|

Transgenic plants: Disease resistance; Insect resistance, virus resistance, Biotic and abiotic stress resistance, Modification of seed protein quality, Chloroplast and Mitochondria functions, GM Crops- Prospects and problems, Current research in genetically modified plants. Guidelines and safety regulations for transgenic plants.

| 5 | APPLICATIONS OF PLANT BIOTECHNOLOGY | Total Hrs | 9 |
|---|---|---|---|

Biofertilizers: *Azospirillum*, *Rhizobium*, Nif genes, Nod genes, mechanism of biological nitrogen fixation in leguminous plants. Blue green algae and Mycorrhiza, Applications of Antisense RNA technology. Plant derived vaccines: Edible vaccines, Subunit vaccine, Plantigens and Plantibodies, Phytoremediation.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :


1. Singh, B.D., “Biotechnology”, First Edition, Kalyani Publishers, New Delhi, India, 2005.
2. Ponmurugan, P. and Suresh Kumar, K. “Applications of Plant tissue culture”, New Age Internationals, New Delhi, India, 2011.


Reference(s) :


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

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
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<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 612</td><td colspan="2">ANIMAL BIOTECHNOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">To develop the skills of the students in the area of Animal Biotechnology and its wide applications. To widen the knowledge about the production and applications of Transgenic animals.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION TO ANIMAL CELL LINE</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Introduction to Animal cell culture, Basic tissue culture techniques, Animal cell culture media and its preparations, Types of primary culture - Chicken embryo fibroblast culture - Chicken liver and kidney culture - Secondary culture –Trypsinization, Suspension cultures, dependent culture, Continuous flow cultures, Immobilized cultures, Role of serum and supplements, Mass transfer in mammalian cell culture. Maintenance and preservation of animal cell cultures; Measurement of viability and cytotoxicity.</td></tr>
<tr><td>2</td><td colspan="5">PRODUCTION OF TRANSGENIC ANIMALS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Cloning techniques in animals, Therapeutic cloning, Gene transformation techniques in animals: Physical and chemical methods of gene transfer, Embryonic stem cell transfer. Artificial animal breeding: In vitro fertilization, Embryo transfer and Nuclear transplantation.</td></tr>
<tr><td>3</td><td colspan="5">TRANSGENIC ANIMAL TECHNOLOGY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Transgenic animals: Transgenic mice, genotyping transgenic mice by PCR, Transgenic rabbits, Transgenic cattle, Transgenic Pig and Transgenic Fish, Embryo sex determination, In vitro manipulations for embryo production, Artificial insemination. Ultrasonic Cell disruption, Ethical issues related to transgenic animals.</td></tr>
<tr><td>4</td><td colspan="5">SCALE-UP PROCESS IN CELL CULTURE</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Cell culture reactors, Scale-up in suspension, Scale and complexity, Mixing and aeration, Rotating chambers, Perfused suspension cultures, Fluidized bed reactors for suspension culture, Scale-up in monolayers, Multisurface propagators, Multiarray disks, spirals and tubes, Roller culture, Microcarriers, Perfused monolayer cultures, Membrane perfusion, Hollow fiber perfusion, Matrix perfusion, Microencapsulation and Growth monitoring.</td></tr>
<tr><td>5</td><td colspan="5">APPLICATIONS OF ANIMAL BIOTECHNOLOGY</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Animal vaccines: killed vaccines, live vaccines and Genetic vaccines, Application of animal cell culture for in vitro testing of drugs, Testing for toxicity in environment, Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Protein expression in animal cell line.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book(s) :</td></tr>
<tr><td>1</td><td colspan="8">Singh, B. D., “Biotechnology”, First Edition, Kalyani Publishers, New Delhi, India, 2005.</td></tr>
<tr><td>2</td><td colspan="8">Ranga, M. M., “Animal Biotechnology”, Second Edition, Agrobios India limited, Jodhpur. India, 2002.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Rama Dass, P. and Meera Rani, S., “Text Book of Animal Biotechnology”, Akshara Printers, New Delhi. India, 1997.</td></tr>
<tr><td>2</td><td colspan="8">Masters, J. R. W., “Animal Cell Culture”, Practical Approach, Oxford University Press, UK, 2000.</td></tr>
<tr><td>3</td><td colspan="8">Ian freshney, R., “Culture of Animal Cells”, 5th Edition, Wiley Publications, New Delhi, India, 2006.</td></tr>
</table>

| K.S.Rangasamy College of Technology – Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester VI

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 613 | MOLECULAR MODELING AND DRUG DESIGNING | 3 | 1 | 0 | 4 | 50 | 50 | 100 |

| Objective(s) | At the end of the course, the student would have gained knowledge in various aspects of Molecular Modelling and Drug Designing. This will facilitate the student to take up higher studies in the area. |
|---|---|

| I. | CONCEPTS IN MOLECULAR MODELING | Total Hrs | 12 |
|---|---|---|---|

Introduction; Coordinate System; potential energy surfaces molecular graphics; Components of Molecular Graphics hardware and software; Mathematical concepts – introduction of molecular mechanics and quantum mechanics.

| 2. | MOLECULAR MECHANICS | Total Hrs | 12 |
|---|---|---|---|

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

| 3. | MOLECULAR DYNAMICS SIMULATION METHODS | Total Hrs | 12 |
|---|---|---|---|

Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time-dependent properties; Solvent effects in Molecular Dynamics; Conformational changes from Molecular Dynamics simulation.

| 4. | MOLECULAR MODELING IN DRUG DISCOVERY | Total Hrs | 12 |
|---|---|---|---|

Deriving and using 3D pharmacophore; Molecular Docking; Structure-based methods to identify lead compounds, Mechanism of their action ; *de novo* ligand design; Applications of 3D Database Searching and Docking.

| 5. | STRUCTURE ACTIVITY RELATIONSHIP | Total Hrs | 12 |
|---|---|---|---|

QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors. Use of Genetic Algorithms, Neural Networks and Principle Components Analysis in the QSAR equations.

| Total Hours Taught | 60 |
|---|---|

Text book(s) :

| 1. | Andrew R. Leach “Molecular Modeling – Principles and Applications”; Second Edition, Pearson Education Ltd., UK, 2010. |
|---|---|

Reference(s) :

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

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<tr><td colspan="7">K.S.Rangasamy College of Technology – Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
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<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 614</td><td>HEAT AND MASS TRANSFER OPERATIONS</td><td>3</td><td>1</td><td>0</td><td>4</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">At the end of the course the students would have learnt about heat transfer, heat exchangers and mass transfer and their applications in biotechnology. Thus this will be very useful for the student to study specialized courses in engineering offered in the subsequent semesters.</td></tr>
<tr><td>1.</td><td colspan="5">BASICS OF HEAT TRANSFER OPERATIONS</td><td colspan="2">Total Hrs 12</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>2.</td><td colspan="5">HEAT EXCHANGERS AND HEAT TRANSFER WITH PHASE CHANGE</td><td colspan="2">Total Hrs 12</td></tr>
<tr><td colspan="7">Heat exchangers-shell and tube and double pipe heat exchangers, flow arrangements in heat exchangers, energy balance, LMTD, single and multiple effect evaporators; natural and forced circulation evaporators; heat transfer in condensation of single vapour, drop wise condensation and film wise condensation, heat transfer to boiling liquids.</td></tr>
<tr><td>3.</td><td colspan="5">DIFFUSION AND LIQUID-VAPOUR MASS TRANSFER</td><td colspan="2">Total Hrs 12</td></tr>
<tr><td colspan="7">Diffusion: Molecular diffusion, Fick’s law of diffusion, steady state molecular diffusion in gases a liquids, mass transfer coefficients, penetration and surface renewal theories, diffusivity and t calculations; Simple distillation<br>Continuous rectification-binary systems, Mc Cabe thiele analysis and calculations.</td></tr>
<tr><td>4.</td><td colspan="5">LIQUID-GAS/LIQUID MASS TRANSFER</td><td colspan="2">Total Hrs 12</td></tr>
<tr><td colspan="7">Absorption: Selection criteria for solvents, material balance, minimum liquid-gas ratio, calculations on circulation rate and composition; Industrial absorbers - types, characteristics and channelling of tower packings, Liquid-liquid extraction-distribution co-efficient, ternary systems and triangular diagrams, Solvent selection criteria for extraction, extraction equipments, material balance calculations.</td></tr>
<tr><td>5.</td><td colspan="5">APPLICATIONS OF HEAT AND MASS TRANSFER IN BIOLOGICAL SYSTEMS</td><td colspan="2">Total Hrs 12</td></tr>
<tr><td colspan="7">Heat transfer in bioreactors, Relationship between heat transfer, cell concentration and stirring conditions. Role of diffusion in bioprocessing, film theory, Oxygen uptake in cell cultures-oxygen transfer to cell, Oxygen transfer in fermenters-bubbles; sparging, stirring and medium properties; anti foam agents, temperature, gas pressure; mass transfer correlations, measurement of dissolved oxygen concentration.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>60</td></tr>
<tr><td colspan="8">Text book(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Gavhane, K. A., “Unit Operations-II”, 23rd Edition, Nirali Prakasan Publication, Pune, India, 2009.</td></tr>
<tr><td>2.</td><td colspan="7">Pauline M. Doran “Bioprocess Engineering Principles” First Edition, Academic Press, California, US, 2005.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">Treybal, R. E. “Mass Transfer Operations”, Third Edition, McGraw-Hill, New Delhi, India,</td></tr>
<tr><td>2.</td><td colspan="7">McCabe, W.L., and Smith J.C. “Unit Operations of Chemical Engineering”. Fifth Edition, McGraw Hill, Singapore, 1993.</td></tr>
</table>

| K.S.Rangasamy College of Technology – Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester VI** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 6P1 | PLANT AND ANIMAL BIOTECHNOLOGY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective (s) | The student would have learnt about the applications of genetic engineering in plant and how to develop Transgenic plants. The student would have learnt about animal cell culture, molecular diagnostic of animal diseases and transgenic animal production. | | | | | | | |
| (12 experiments) | | | | | | | | |
| S.No. | Name of the experiments | | | | | | | |
| | PLANT BIOTECHNOLOGY | | | | | | | |
| 1 | Preparation of Media and Growth hormones | | | | | | | |
| 2 | *In vitro* seed germination | | | | | | | |
| 3 | Organ culture | | | | | | | |
| 4 | Haploid plant production (Ovary and Pollen culture) | | | | | | | |
| 5 | Multiplication of plant through Micropropagation | | | | | | | |
| 6 | Callus culture | | | | | | | |
| 7 | *Agrobacterium* mediated gene transformation and hairy root culture | | | | | | | |
| 8 | Preparation of synthetic seed | | | | | | | |
| 9 | Somatic Embryogenesis | | | | | | | |
| | ANIMAL BIOTECHNOLOGY | | | | | | | |
| 10 | Preparation of tissue culture medium and Membrane filters | | | | | | | |
| 11 | Trypsinization of Monolayer and sub culturing | | | | | | | |
| 12 | Isolation of Primary cells from Chicken fibroblast | | | | | | | |
| Total hours to be taught | | | | | | | | 45 |
| Text book(s): | | | | | | | | |
| 1. | Gamborg, O.L. and Philips G.C., "Plant Cell, Tissue and Organ Culture fundamental Methods", Narosa Publishing House, New Delhi, India, 1995. | | | | | | | |
| 2. | Ian Freshney, R., "Culture of Animal Cells", Fifth Edition, Wiley Publications, New Delhi, India, 2006. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester VI** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 6P2 | INDUSTRIAL BIOTECHNOLOGY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | To Educate the theoretical concepts of Bioseparation experimentally to the students. | | | | | | | |

(12 experiments)

| S.No. | Name of the experiments |
|---|---|
| 1. | Production of Citric acid |
| 2. | Production of Ethanol from molasses, grapes and cereals |
| 3. | Production of Antibiotics using *Streptomyces* species |
| 4. | Production of Vitamins |
| 5. | Production of growth regulators |
| 6. | Production of Biofertilizers (N – Fixers & P - Solubilizers) |
| 7. | Production of Biocontrol Agents |
| 8. | Production of Single cell Protein (*Spirulina*) |
| 9. | Production of Vermicompost |
| 10. | Mushroom cultivation |
| 11. | Production of mixed fruits Jam |
| 12. | Production of pickles using vegetables, fruits and meat |

| Total hours to be taught | 45 |
|---|---|

Reference


| 1. | Cruger, W., Cruger, A., “Biotechnology: A textbook of Industrial Microbiology”, Panima Publishing Corporation, New Delhi, India, 2000. |
|---|---|

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester VI

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 6P3 | BIOINFORMATICS AND MOLECULAR MODELING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s): | At the end of the course, the student would have gained knowledge about the various aspects Bioinformatics. | | | | | | | |

(Any 10 experiments)

| S.No. | Name of the Experiments |
|---|---|
| 1. | Biological Databases. |
| 2. | Data Base Searching Tools – BLAST and FASTA |
| 3. | Sequence Alignment<br>a. Pairwise alignment – Global and Local<br>b. Multiple Sequence Alignment – ClustalX. |
| 4. | Phylogenetic Analysis - Phylip. |
| 5. | Structure Visualization Tool |
| 6. | Homology Modeling |
| 7. | 2D Structure Drawing Tools |
| 8. | Lead Optimization Studies |
| 9. | Molecular Docking |
| 10. | Matlab |
| Total hours to be taught | 45 |

Reference Book:


| | |
|---|---|
| 1. | Baxevaris, Reas and Oulletti, F. “Bioinformatics: A Practical guide to the analysis of genes and Proteins”, Wiley – Interscience Publication, Canada, 1998. |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
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| Department | Biotechnology | | Programme Code & Name | | | BT : B.Tech Biotechnology | | |
| **Semester VI** | | | | | | | | |
| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 TP 0P4 | Career Competency Development IV | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| Objective(s) | To enhance employability skills and to develop career competency | | | | | | | |

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

Evaluation Criteria

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

Reference Books


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


Note:

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

| Modules | 10 HS 001 – PROFESSIONAL ETHICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Learn about the concept of ethics and the core qualities of professional practitioners, Getting the awareness about the ethical issues and theories related to ethics & values |
| 2. | Understanding the difference between moral dilemmas and moral autonomy |
| 3. | Learn from the past experiences, Knowing the role of engineers and learn about the code of ethics |
| 4. | Analyzing the Space shuttle challenger case study, Analyze the global issues with case study |
| 5. | Identify the responsibilities of engineers for safety and risk, Designing for safety and analyzing the risk benefits |
| 6. | Learn about various case studies related with disasters. |
| 7. | Understand the professional rights and responsibilities with confidentiality and loyalty in work place, Understanding the difference between bribe and gift |
| 8. | Classify the types of whistle blowing and to learn about occupational crimes with cases |
| 9. | Gaining knowledge about the cross cultural issues and computer ethics |
| 10. | Knowing the effectiveness of weapon development in military, Getting the awareness about the IPR |

| Modules | 10 BT 611 - PLANT BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the basic concepts of plant tissue culture, media preparation in the field of *in vitro* culture of plants. |
| 2. | Discriminate the applications of different techniques applied in plant tissue culture. |
| 3. | Defend the process of producing hybrid plants using plant tissue culture techniques. |
| 4. | Investigate the importance of preserving the germplasm for future prosperity. |
| 5. | Describe the concept of direct gene transformation along with vector mediated gene transformation. |
| 6. | Summarize the role of various r DNA techniques applicable to plants. |
| 7. | Investigate the various method of biotic and abiotic disease resistance and modification of seed protein quality. |
| 8. | Learn the prospects and problems of GM crops along with the guidelines as well as safety regulations for transgenic plants. |
| 9. | Discriminate the mechanism of biological nitrogen fixation and understand the role of various biofertilizers and to remediate the pollutants using plants. |
| 10. | Determine the applications of antisense rDNA technology along with the production various plant vaccines |

| Modules | 10 BT 612 - ANIMAL BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the basic animal cell culture techniques and the role of various types of media used in animal cell cultures. |
| 2. | Discuss the primary and secondary animal cell culture and their types. |
| 3. | Define and compare the various techniques of cloning and artificial breeding of animals |
| 4. | Distinguish between physical and chemical modes of gene transfer for the production of transgenic animals. |
| 5. | Outline the various types of transgenic animals and the mode of determining the sex of the embryo. |
| 6. | Sequence the steps and ethical issues involved in artificial insemination process and production of transgenic animals |
| 7. | Distinguish suspension culture and monolayer culture for mass multiplication of animal cells |
| 8. | Design a reactor for scale-up of suspension cultures and monitoring of cell growth |
| 9. | Appraise the use of animal cell culture in production of various vaccines for human welfare |
| 10. | Summarize the applications of cell culture technology for *in vitro* testing of drugs and protein expression in animal cell culture |

| Modules | 10 BT 613 - MOLECULAR MODELING AND DRUG DESIGNING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the basic concepts of coordinate systems and the components needed for molecular graphics in hardware and software. |
| 2. | Illustrate the applications of mathematics in molecular modeling and basics for molecular and quantum mechanics. |
| 3. | Determine the features of force field calculations with their basic laws on the behavior of bonded and nonbonded interactions. |
| 4. | Generate the energy function for a macromolecule and probe the applications of energy minimization. |
| 5. | Describe the different models of molecular dynamics and the simulation process under constant temperature and pressure. |
| 6. | Summarize the properties and functions involved in solvent effects and the process performed in conformational changes. |
| 7. | Analyze the methods concerned in docking studies and the methods involved in ligand designing |
| 8. | Determine the available 3D databases for drug designing and understand the steps involved in drug discovery. |
| 9. | Describe the methods and concept for QSAR and descriptors used for pharamacophore mapping. |
| 10. | Determine the soft computing techniques and their applications in rational drug designing. |

| Modules | 10 BT 614 - HEAT AND MASS TRANSFER OPERATIONS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Understand the basics of heat transfer operations, conductance and resistance using Fourier's law and different modes of heat energy. |
| 2. | Calculate heat flow through plane wall, composite wall, cylindrical surface and sphere and heat transfer coefficients. |
| 3. | Quantify the heat energy and energy balance in the different types heat exchangers with various flow arrangements. |
| 4. | Develop the model for the heat utilization and rejection in evaporators and condensation processes with phase change operation. |
| 5. | Describe the mechanism of diffusion in mass transfer operation and mass transfer theories for various states of fluids. |
| 6. | Design and solve the operational and control issues in distillation process by McCabe-thiele analysis. |
| 7. | Select the suitable solvents with respect to the L/G mass transfer, minimum solvent requirements, and maximum circulation rate for absorption operation in chemical industries. |
| 8. | Develop the design equation and model the process operation for absorption and extraction equipment applicable to industrial process. |
| 9. | Characterize the relationship between heat transfer, cell concentration and stirring of diffusion in biological process. |
| 10. | Study the oxygen up take rate, transfer rate and dissolved oxygen concentration in fermentation medium and bioreactors. |

| Modules | 10 BT 6P1 - PLANT AND ANIMAL BIOTECHNOLOGY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Adapt the preparation of plant tissue culture media for plant cell, tissue and organ culture with effective and safe operation. |
| 2. | Illustrate the steps involved in developing a reliable protocol for *in vitro* culturing of plants. |
| 3. | Calculate the required hormonal combination for various *in vitro* plant production techniques. |
| 4. | Experiment the aseptic explant production through *in vitro* seed germination, |
| 5. | Observe the formation of multiple shoots branches from micro propagated explants and apply the technology for mass plant propagation. |
| 6. | Adapt callus culture from tissues of medicinal plants and to observe the growth pattern of callus culture. |
| 7. | Dissect the production of haploid plants and their application along with their importance for hybridization. |
| 8. | Illustrate the basic concepts of *Agrobacterium* mediated gene transformation. |
| 9. | Operate a reliable procedure to produce and study the ontology of somatic embryos for synthetic seed preparation for transgenic plant production. |
| 10. | Adapt the preparation of animal cell culture media and to know about trypsinization, sub culturing process for the production of transgenic animals. |

| Modules | 10 BT 6P2- INDUSTRIAL BIOTECHNOLOGYLABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the steps involve in developing protocol for production of citric acid |
| 2. | Demonstrate the steps involved production of ethanol from molasses, grapes and cereals. |
| 3. | Outline the process for production Antibiotics using *Streptomyces* species. |
| 4. | Interpret the production process of vitamins. |
| 5. | Illustrate the importance of growth regulators obtained from commercial important microbes. |
| 6. | Demonstrate the formulation of biofertilizers using nitrogen fixing and phosphate solubilizing bacteria. |
| 7. | Analysis the antagonist activity of biocontrol agents against pathogens |
| 8. | Adapt suitable protocol for the production of single cell protein. |
| 9. | Demonstrate the production process of vermicompost and mushrooms. |
| 10. | Exhibit the steps involved production of mixed fruit jam and pickle. |

| Modules | 10 BT 6P3 – BIOINFORMATICS AND MOLECULAR MODELING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Annotate the various biological data from different biological database |
| 2. | Determine the similarity between the sequences using BLAST and FASTA |
| 3. | Analyze the arrangement of sequences like DNA, RNA, or protein and to probe the regions of similarity and identity among them |
| 4. | Analyze the evolutionary relationships among the organisms through phylogentic tools |
| 5. | Infer and configure the structural conformations of proteins |
| 6. | Elucidate the 3D structure of the target protein from its amino acid sequence |
| 7. | Draw and configure the two dimensional structure of the small molecules |
| 8. | Evaluate the stability, absorption, distribution, bioavailability and toxicity of the lead compounds |
| 9. | Probe the interaction of the proteins with ligands and predict the orientation of the molecule bound with each other |
| 10. | Read, analyze and visualize genomic, proteomic and microarray data using MATLAB |

| Modules | 10 TP 0P4 - Career Competency Development IV<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate the ability in solving the problems |
| 2. | Analyse and conclude the problem according to the given information |
| 3. | Solve the problem with appropriate programming languages |
| 4. | Analyse their capabilities in team work |
| 5. | Express their in-depth technical knowledge and interpersonal skills |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester VII** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 HS 002 | TOTAL QUALITY MANAGEMENT | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management, statistical approach for quality control, ISO and QS certification process and its need for the industries. | | | | | | | |
| 1 | INTRODUCTION | | | | Total Hrs | 9 | | |
| Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Quality Council, Quality Statements, Deming Philosophy, Barriers to TQM Implementation. | | | | | | | | |
| 2 | TQM PRINCIPLES | | | | Total Hrs | 9 | | |
| Customer satisfaction, Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement, Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership, Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures-Basic Concepts, Strategy. | | | | | | | | |
| 3 | STATISTICAL PROCESS CONTROL (SPC) | | | | Total Hrs | 9 | | |
| The tools of quality, Statistical Fundamentals, Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New Management tools. | | | | | | | | |
| 4 | TQM TOOLS | | | | Total Hrs | 9 | | |
| Benchmarking, Reasons to Benchmark, Benchmarking Process, Quality Circle, Quality Function Deployment (QFD). House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), Concept, Improvement Needs, FMEA–Stages, Types. | | | | | | | | |
| 5 | QUALITY SYSTEMS | | | | Total Hrs | 9 | | |
| Need for ISO 9000 Quality Systems, ISO 9001:2008 ISO 14000 Quality Systems, Elements Concepts, Implementation, Documentation, Quality Auditing, Requirements and Benefits, Non Conformance report, Case Studies on Educational System. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1 | Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education Asia, 1999. (Indian reprint 2002). | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | James R.Evans & William M.Lidsay, “The Management and Control of Quality”, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5). | | | | | | | |
| 2 | Feigenbaum.A.V. “Total Quality Management”, McGraw Hill, 1991. | | | | | | | |
| 3 | Jayakumar.V, Total Quality Management-Lakshmi Publications, 2006. | | | | | | | |
| 4 | Suburaj, Ramasamy “Total Quality Management”, Tata McGraw Hill, 2005. | | | | | | | |

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | R 2010 |
|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |

## Semester VII

| Course Code | Course Name | Hours / Week | | Credit | Maximum Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 711 | IMMUNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | To introduce the concept of immune response in a mammalian host thereby emphasize their significance in innovation in developing therapeutic modalities for immunological disorders of humans, to orient the students to the biology of the immune system |
|---|---|

| 1. | THE CELLS OF IMMUNE SYSTEM | Total Hrs | 9 |
|---|---|---|---|

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

| 2. | HUMORAL IMMUNITY | Total Hrs | 9 |
|---|---|---|---|

Development, maturation, activation and differentiation of B-cells; Antibody- Classes and subclasses; antibody diversity- Antigen and antibody interaction. Complement - Hybridoma technology for production of the monoclonal antibody.

| 3. | CELLULAR IMMUNITY | Total Hrs | 9 |
|---|---|---|---|

Thymus derived (T) Lymphocytes: Classification and stages of development- T cell receptor gene rearrangement- Major histocompatibility complex mechanism of phagocytosis- the cell biology of antigen processing and presentation.

| 4. | IMMUNITY TO INFECTIONS AND HYPERSENSIVITY REACTIONS | Total Hrs | 9 |
|---|---|---|---|

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immunodeficiencies; resistance and immunization; Vaccines.

| 5. | TRANSPLANTATION, AUTOIMMUNITYT AND IMMUNOLOGY OF TUMORS | Total Hrs | 9 |
|---|---|---|---|

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

| Total hours to be taught | 45 |
|---|---|

Text book (s) :


1. Kuby, J. H. "Immunology", 5th Ed., W. H. Freeman Publication, New York, USA, 2002.
2. Abbas, K. A., Litchman, A. H. and Pober, J. S. "Cellular and Molecular Immunology", 4th Ed., W. B. Saunders Co., Pennsylvania, USA, 2005.


Reference(s) :


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

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## Semester VII

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 712 | BIOPHARMACEUTICAL TECHNOLOGY | 3 | 1 | 0 | 4 | 50 | 50 | 100 |

| Objective(s) | At the end of the course, the students would have learnt about What are Drugs, Drug action, Drug metabolism, and various dosage forms of Biopharmaceuticals to facilitate the students to take up projects in this area of Pharmaceutical Biotechnology. |
|---|---|

| 1. | PHARMACEUTICALS, BIOLOGICS AND BIOPHARMACEUTICALS | Total Hrs | 12 |
|---|---|---|---|

Introduction to pharmaceutical products, Biopharmaceuticals and pharmaceutical biotechnology, Biopharmaceuticals: current status and future prospects, Pharmaceuticals of animal origin, Pharmaceutical substances of plant origin, Pharmaceutical substances of microbial origin, Drug discovery, The impact of genomics and related technologies upon drug discovery, Gene chips,Proteomics,Patenting,Clinical trials, Clinical trial design,

| 2. | THE DRUG MANUFACTURING PROCESS | Total Hrs | 12 |
|---|---|---|---|

International pharmacopoeia, The manufacturing facility, Cleaning, decontamination and sanitation (CDS), Documentation, Specifications, Records, Additional production systems: yeasts, Fungal production systems, Transgenic animals, Transgenic plants, Immunological approaches to detection of contaminants,Pyrogen detection, Validation studies

| 3. | CYTOKINES AND GROWTH FACTORS | Total Hrs | 12 |
|---|---|---|---|

Cytokines, Cytokines as biopharmaceuticals, The interferons,Tumour necrosis factors (TNFs),The interleukins as haemopoietic growth factors, Leukaemia inhibitory factor (LIF),Erythropoietin (EPO), Thrombopoietin, Hormones of therapeutic interest Insulin. The insulin receptor and signal transduction, Recombinant hGH (rhGH) and pituitary dwarfism.

| 4. | BLOOD PRODUCTS AND THERAPEUTIC ENZYMES | Total Hrs | 12 |
|---|---|---|---|

Platelets and red blood cells, Blood substitutes, Tissue plasminogen activator (tPA), Urokinase, Staphylokinase, Antibodies, vaccines and adjuvants, Therapeutic application of monoclonal antibodies, Traditional vaccine preparations, Toxoids, antigen-based and other vaccine preparations, Oil-based emulsion adjuvant.

| 5. | NUCLEIC ACID THERAPEUTICS | Total Hrs | 12 |
|---|---|---|---|

Gene therapy, Basic approach to gene therapy, Vectors used in gene therapy, Retroviral vectors, Additional viral-based vectors, Manufacture of viral vectors, on-viral vectors, Manufacture of plasmid DNA,Gene therapy and genetic disease, Gene therapy and cancer, Gene therapy and AIDS, Gene-based vaccines, Gene therapy, Anti-sense technology, Anti-sense oligonucleotides, Antigene sequences and ribozyme.

| Total Hours to be Taught | 60 |
|---|---|

Text book (s) :


1. Gary Walsh, “Biopharmaceuticals”, John Wiley & Sons Ltd, UK, Second Edition, 2003.
2. Remington, “The Science and Practice of Pharmacy”. Lippincott Williams and Wilkins, 20th Edition, 2001.


Reference(s) :


1. Katzung, B. G. “Basic and Clinical Pharmacology”, Prentice Hall of India, New Delhi, 1995.
2. Tripathi, K. D. “Essentials of Medical Pharmacology”, Jaypee Brothers Medical Publishers (P) Ltd. 6th Edition, John Wiley, New Delhi, 2000.

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td>Department</td><td colspan="2">Biotechnology</td><td colspan="2">Program code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester VII</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>10 BT 713</td><td>NANOBIOTECHNOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="8">At the end of the course, the students would have gained extensive knowledge in Nanobiotechnology, involvement macromolecules in Nanobiotechnology and its application in medicine chemistry and agriculture.</td></tr>
<tr><td>1</td><td colspan="5">INTRODUCTION TO NANOBIOTECHNOLOGY</td><td>Total Hrs.</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Introduction to Nanobiotechnology-micro and nanosystems , Nanoparticles types and properties - fullerness: properties and characterization – carbon nano tubes: -quantum dots- nanopores.- Nanoshells- nanocomposites.</td></tr>
<tr><td>2</td><td colspan="5">SYNTHESIS OF NANOMATERIALS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Synthesis of nanoscale materials- (top down and bottom up approaches) – Physical method-Ball milling-Plasma Arcing-Laser Ablation Method, Chemical method Sol gels – Chemical Vapour Deposition-Biological method using microorganisms- characterization methods –XRD, FTIR, SPM.</td></tr>
<tr><td>3</td><td colspan="5">NANOMOLECULES IN BIOSYSTEMS</td><td>Total Hrs.</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Introduction –Lipids as nano bricks and mortar-lipid structure-self organizing supra molecular structures, Proteins-S Layer proteins, Nanoscale motors –based on bacteriorhodopsin –ion channels as sensors , -DNA –DNA based artificial nanostructures-DNA as nanowires- DNA computers.</td></tr>
<tr><td>4</td><td colspan="5">MICROORGANISMS IN NANOBIOTECHNOLOGY</td><td>Total Hrs.</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Nanobiotechnology and Microorganisms –PHA in nanoBiotechnology –cyaophycin inclusions-magnetosomes- alignates- bacteriophages- bacterial spores, Synthesis of Gold ,Silver and Silica Nanoparticles.</td></tr>
<tr><td>5</td><td colspan="5">APPLICATION OF NANOBIOTECHNOLOGY</td><td>Total Hrs.</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Application of nanobiotechnology in drug delivery-nanoscale devices for drug delivery-–-microarray, nanobiosensors and nanobiochips. Nanotechnology for cancer diagnosis and treatment. nanoparticles as biocontrol agents in plants.</td></tr>
<tr><td colspan="7">Total Hours Taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="8">Mick Wilson, Kamali Kannangara, Geoff Smith and Michelle Simmonsoms, “Nanotechnology Basic science and emerging technologies”, Overseas Press India Private Limited, New Delhi, India, 2005.</td></tr>
<tr><td>2.</td><td colspan="8">Niemeyer C. M. and Mirkin C. A., 2004 “Nanobiotechnology – Concepts, applications and perspectives” Wiley VCH Publishers, New Delhi, India, 2004.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="8">Rosenthal, S.J. and Wright, D.W., “Nanobiotechnology Protocols in Methods in Molecular Biology Series”, Humana Press, USA, 2007.</td></tr>
<tr><td>2.</td><td colspan="8">Ralph, S. Greco, Fritz B. Prinz and Lane, R., “Nanoscale Technology in biological systems”, Smithm CRC Press, California, USA, 2005.</td></tr>
</table>

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology | | | | | |
| **Semester VII** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 714 | DOWNSTREAM PROCESSING | 3 | 1 | 0 | 4 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the student would have learnt about, methods to obtain pure proteins, enzymes and in general about product development in R & D. This will be handy for projects of Industries. | | | | | | | |

| 1. | INTRODUCTION TO DSP AND INTRACELLULAR PRODUCT RELEASE | Total Hrs | 12 |
|---|---|---|---|

Introduction to downstream processing, Characteristics of biomolecules, economics of downstream processing, cost cutting strategy, physico chemical basis of bioseparation. Location of products and product release kinetics, cell disruption for product release: Mechanical methods-bead mill, high pressure homogenizer, enzyme digestion, chemical methods-alkali treatment, detergent solubilization, cell wall permeabilization, pretreatment and stabilization of bioproducts.

| 2. | PRIMARY SEPARATION AND ISOLATION | Total Hrs | 12 |
|---|---|---|---|

Principle of batch filtration - Darcy 's law, compressible and incompressible cakes, pretreatment of fermentation broth, design of industrial filters-plate and frame filter press, leaf filter, Continuous filtration-rotary drum filter, Centrifugation: Principle, design of Industrial centrifuges-tubular bowl, Disc bowl and basket centrifuge, ultra and differential centrifugation, scale up of centrifugation.

| 3. | PRODUCT RECOVERY AND CONCENTRATION | Total Hrs | 12 |
|---|---|---|---|

Adsorption: adsorption isotherms, batch adsorption, adsorption in CSTR, adsorption in fixed bed. Principle of Liquid-Liquid extraction, cloud point extraction and aqueous two phase extraction of biomolecules. Membrane separation processes: Microfiltration, ultrafiltration, reverse osmosis and dialysis and electro dialysis and liquid membranes. Precipitation of proteins by different methods.

| 4. | FINAL PRODUCT PURIFICATION AND POLISHING | Total Hrs | 12 |
|---|---|---|---|

Chromatography: Principle and practice of adsorption, ion exchange, size exclusion, bioaffinity, hydrophobic interaction, reverse phase and pseudo affinity chromatographic techniques. Crystallization: Nucleation, crystal growth, crystal size distribution, population density, industrial crystallizers. Drying: drying terminologies, drying curve, industrial dryers, freeze drying principles and applications.

| 5. | PROBLEMS IN DOWNSTREAM PROCESSING | Total Hrs | 12 |
|---|---|---|---|

Problems to find filtration time in continuous filtration, problems to find specific cake resistance, filter medium resistance and compressibility of filter cake. Problems to find settling velocity, angular velocity, ∑ factor and number of discs in centrifugation. Problems in adsorption isotherms and break point time in fixed bed adsorption. Problems related to relative humidity and population density.

| Total hours to be taught | 60 |
|---|---|

Text book (s) :


1. Belter, P. A., Cussler E.L. and Wei-Houhu "Bioseparations – Downstream Processing For Biotechnology", Wiley Interscience Pub., New Delhi, India, 1988.
2. Jenkins, R.O., (Ed.) – "Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth"-Heinemann, 1992.
3. Sivasankar, B., Bioseparation s– Principles and Techniques, Prentice Hall of India Private Limited, New Delhi, 2006.


Reference(s) :


1. Nooralabettu Krishna Prasad "Downstream Process Technology-A New Horizon In Biotechnology" PHI Learning Private Limited, New Delhi, 2012.
2. Scopes, R. K., "Protein Purification – Principles And Practice" Narosa Pub., New Delhi, India, 1994.


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|---|---|

| Department | Biotechnology | Program code & Name | BT : B.Tech Biotechnology |
|---|---|---|---|

## Semester VII

| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT 7P1 | IMMUNOLOGY LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | To develop skills of the students in the area of Immunology. At the end of the course the students would have learnt about the Immunology Techniques. This knowledge will be very useful for students to study specialized subjects in Biotechnology. | | | | | | | |

| S.No. | Name of the Experiments |
|---|---|
| 1. | Handling of animals and raising of antibodies in rats (Demonstration) |
| 2. | Blood collection, grouping, serum and plasma separation |
| 3. | Differentiation and identification of blood cells |
| 4. | Ouchterlony double immune diffusion (ODID) test |
| 5. | Immunoelectrophoresis |
| 6. | Radial immune diffusion |
| 7. | Rapid Plasma Reagin (RPR) test |
| 8. | WIDAL –slide and tube test |
| 9. | C-reactive protein test |
| 10. | ELISA- Sandwich |

| Total hours to be taught | 45 |
|---|---|

Reference :


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

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Program code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester VII** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 7P2 | DOWN STREAM PROCESSING LABORATORY | 0 | 0 | 3 | 2 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the student has gained the knowledge to perform various techniques used in Down Stream Processing and how to make a finished project. | | | | | | | |

| S.No. | Name of Experiments |
|---|---|
| 1. | Studies on cell disruption and cell Separation by using sonication method |
| 2. | Separation of solid and liquid using centrifugation method |
| 3. | Studies on sedimentation |
| 4. | Enzyme purification by isoelectric precipitation |
| 5. | Enzyme purification by acetone precipitation |
| 6. | Studies on Filtration using plate and frame filter press |
| 7. | Aqueous two phase Extraction |
| 8. | Studies on simple Leaching |
| 9. | Studies on Column Chromatography with different solvents |
| 10. | Studies on ammonium sulphate precipitation |
| 11. | Product polishing – freeze drying |
| Total hours to be taught | 45 |

Reference(s) :


1. Jenkins R. O., (Ed.) – "Product Recovery In Bioprocess Technology"- Biotechnology By Open Learning Series, Butterworth-Heinemann, 1992.
2. Belter P. A., Cussler E.L. And Wei-Houhu., "Bioseparations – Downstream Processing For Biotechnology", Wiley Interscience Pub.1988.


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|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Semester VII** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | TOTAL |
| 10 BT 7P3 | PROJECT WORK- PHASE I | 0 | 0 | 4 | 2 | 100 | 00 | 100 |
| Objective(s) | To make the student understand the practical problem solving process in the industry. | | | | | | | |

| | |
|---|---|
| 1. | Each student has to select a project from any industrial related problems or |
| 2. | innovations in technology or critical studies related to different aspects of during |
| 3. | the VII semester. The student must undertake the project work individually. The |
| 4. | works to be undertaken during this phase is given below: |
| 5. | Identifying the area of proposed project work |
| 6. | Selecting a suitable name for the above work |
| 7. | Identifying the problem areas in biotechnology industry for the proposed work |
| 8. | Collecting relevant literature for the above work |
| 9. | Framing the methodology for the experimental design |
| 10. | Making all the above works into bound book form |
| | Appearing for Viva-voce examination at the end of semester |
| | Total Hours 60 |

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|---|---|---|---|---|---|---|---|---|
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## Semester VII

| Course Code | Course Name | Hours/Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 TP 0P5 | Career Competency Development V | 0 | 0 | 2 | 0 | 100 | 00 | 100 |
| Objective(s) | To enhance employability skills and to develop career competency | | | | | | | |

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

Evaluation Criteria

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

Reference Books


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


Note:

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

| Modules | 10 HS 002 - TOTAL QUALITY MANAGEMENT<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Understand the dimensions of quality, quality planning. |
| 2. | Analzye and compare different types of quality cost andtechniques for quality cost. |
| 3. | Know the different concept of TQM, quality statement and quality council. |
| 4. | Understand the concepts of customer satisfaction ,complaints and service quality |
| 5. | Know about employee's involvement, Empowerment, Teams and rewards. |
| 6. | Understand the concepts of continuous process improvement techniques and importance of suppliers partnering selection and rating. |
| 7. | Evaluating the basic statistical concepts pertaining to quality new management tools basic concepts of six sigma. |
| 8. | Provide the importance of benchmarking and quality function deployment. |
| 9. | Gaining knowlegde about concepts, types, need of FMEA. |
| 10. | Understand the need for ISO 9000, ISO 14000 quality systems. and benefits of quality auditing. |

| Modules | 10 BT 711 - IMMUNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Differentiate immunogens, antigens, haptens and adjuvants with respect to immunological functions. |
| 2. | Understand the developmental behaviors of B cells and study antigen and antibody interaction |
| 3. | Develop the monoclonal antibodies through hybridoma technology for humoral immunity. |
| 4. | Classify various stages of development of T cell receptor in cellular immunity. |
| 5. | Apply the mechanism of biology of antigen processing and presentation. |
| 6. | Describe the injury and inflammation and the broad education is necessary to understand AIDS. |
| 7. | Study the function as immune responses to infections to ensure immunity. |
| 8. | Understand the mechanism of immune responses with respect to transplantation and graft rejection. |
| 9. | Identify modern techniques to analyze tumor antigens and study autoimmune diseases. |
| 10. | Differentiate immunogens, antigens, haptens and adjuvants with respect to immunological functions. |

| Modules | 10 BT 712 - BIOPHARMACEUTICAL TECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Define and describe Biopharmaceuticals and examples of each category and it's therapeutical applications |
| 2. | Illustrate the different types of drug manufacturing, drug designing obtain from plant, animal, microbial origin and medical applications |
| 3. | Discuss the cleaning, decontamination, sanitation(CDS) and documentation procedures and pyrogen detection in production units |
| 4. | Describe biopharmaceuticals production from transgenic animals and transgenic plants and its therapeutical applications |
| 5. | Characterize the cytokines design, production and packing techniques. |
| 6. | Describe the Human insulin production, storage and application part in diabetes mellitus patients |
| 7. | Determine the strategies involved in blood and blood products like streptokinase, urokinase etc., |
| 8. | Outline the methods involved in MAB's screening, designing and production techniques and rDNA bioproducts like growth factors, interleukins etc., |
| 9. | Illustrate the methods involved in Nucleic acids and therapeuticals production techniques and comprehend the applications of rDNA technology in biopharmaceutical production |
| 10. | Discuss the production of useful molecules like cytokines, vaccines and antibiotics and define the safety guidelines for recombinant DNA technology. |

| Modules | 10 BT 713 - NAOBIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Know the basic concepts in nanobiotechnology and the systems used in nano electronics and microelectronics. |
| 2. | Synthesize different types of nanoparticles such as carbon nanotubes, quantum dots |
| 3. | Classify the methods for nanoscale materials (Top down and Bottom up methods) including ball milling, laser ablation, plasma arcing and chemical vapour deposition. |
| 4. | Characterize nanomaterials using FTIR, XRD and Scanning Probe Microscopy. |
| 5. | Illustrate the mechanism of lipids as nanobricks and nanomortars and its self organizing supramolecular structure. |
| 6. | Explain the role of S Layer proteins, Ion channels, DNA based artificial nanostructure and DNA computers in nanotechnology. |
| 7. | Describe the application of PHA, cyanophycin, magnetosomes in the application of nanotechnology |
| 8. | Understand the mechanism of synthesizing gold, silver and silica nanoparticles from microorganisms. |
| 9. | Apply various nanoscale devices such as microarray, nanobiosensors and biochips for drug delivery systems. |
| 10. | Utilize and apply nanotechnology for cancer diagnosis and treatment and biocontrol agents in plants. |

| Modules | 10BT714 - DOWNSTREAM PROCESSING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the characteristics of biomolecules and cost cutting strategies associated with downstream processing. |
| 2. | Derive the cell disruption kinetics of bead mill and homogenizer and explain the non-mechanical methods of cell disruption. |
| 3. | Design industrial filters and principle of compressibility and resistance. |
| 4. | design tubular, disc bowl and basket centrifuges for the separation of biomolecules |
| 5. | Apply adsorption, aqueous two phase extraction and precipitation principles for the separation of biomolecules. |
| 6. | Describe the operational requirements of membrane separation processes in bioproduct purification. |
| 7. | Characterize chromatographic techniques and their applications in bioseparation. |
| 8. | Illustrate the operational requirements of crystallizer and freeze dryer and their applications. |
| 9. | Solve problems to find filtration time, specific cake resistance in batch filtration and settling velocity. |
| 10. | Solve problems to find relative humidity and population density in final product purification stages. |

| Modules | 10 BT 7P1 - IMMUNOLOGY LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate the handling of animals and raising of antibodies for the experimental purpose. |
| 2. | Collect and identify different blood groups in human beings for human health care |
| 3. | Identify the different types of blood cells and know about their functions. |
| 4. | demonstrate the blood serum and its related functions based on ODID test. |
| 5. | understand the binding of antigen and antibodies and their interaction through ELISA technique. |
| 6. | perform immunoelectrophoresis specificity of the antibody in the serum sample against the antigen |
| 7. | Execute the presence of reagin antibody against syphilis antigen in the patients. |
| 8. | Perform C-reactive protein test for interaction studies. |
| 9. | Execute and demonstrate the prevention of rheumatoid arthritis test. |
| 10. | Demonstrate the identification of typhoid and its seriousness by following WIDAL test. |

| Modules | 10BT7P2 - DOWN STREAM PROCESSING LABORATORY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Demonstrate cell disruption methods by ultrasonication and estimate the amount of protein released |
| 2. | Perform centrifugation to study the effect of density gradient for the separation of moecues |
| 3. | Calculate the area of thickener to study the settling characteristics of slurry by sedimentation. |
| 4. | Examine isoelectric precipitation of proteins |
| 5. | Conduct an experiment to analyze precipitation of proteins using acetone as a precipitating agent. |
| 6. | Estimate filter medium and filter cake resistances for calcium carbonate slurry in plate and frame filter press. |
| 7. | Determine the amount of protein recovered by differential partitioning using aqueous two phase extraction |
| 8. | Perform leaching studies and demonstrate its applications in downstream processing |
| 9. | Analyse separation of pigments by column chromatography |
| 10. | Demonstrate the operating procedure of freeze dryer. |

| Modules | 10 BT 7P3 - Project wok – Phase I<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Identify the thrust areas in engineering, science and technology |
| 2. | Review the literature in related areas of Biotechnology |
| 3. | Identification and collection of research problem in natural science |
| 4. | Design the experimental set up in problematic area |
| 5. | Collection of the data and interpretation in biotechnology |
| 6. | Preparation of work and presentation with effective communication skills |

| Modules | 10 TP 0P5 - Career Competency Development V<br>Course Outcomes(Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Predict and analyse the aptitude and logical skills |
| 2. | Review their verbal ability and written ability |
| 3. | Assess their capabilities among the team members |
| 4. | Prepare for an interview process |
| 5. | Identify the key elements of decision-making in the context of career planning |

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="3">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester VIII</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 HS 003</td><td colspan="2">PRINCIPLES OF MANAGEMENT</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">Knowledge on the principles of management is essential for all kinds of people in all kinds of organizations. After studying this course, students will be able to have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling. Students will also gain some basic knowledge in international aspect of management.</td></tr>
<tr><td>1.</td><td colspan="5">HISTORICAL DEVELOPMENT</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Definition of Management – Science or Art – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organisation.</td></tr>
<tr><td>2.</td><td colspan="5">PLANNING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Nature & Purpose – Types of Plans – Steps involved in Planning – Objectives – Setting Objectives – process of Management by Objectives – Strategies, Policies & Planning Premises – Forecasting – Decision making.</td></tr>
<tr><td>3.</td><td colspan="5">ORGANISING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Nature and purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and limitations – De-Centralization and Delegation of Authority – Staffing – Selection process – Techniques – HRD – Managerial Effectiveness.</td></tr>
<tr><td>4.</td><td colspan="5">DIRECTING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Scope – Human Factors – Leadership – Types of Leadership – Motivation – Hierarchy of needs – Motivation Theories – Motivational Techniques – Job Enrichment – Communication – process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication.</td></tr>
<tr><td>5.</td><td colspan="5">CONTROLLING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">System and process of Controlling – Requirements for effective control – the Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s):</td></tr>
<tr><td>1.</td><td colspan="8">Harold Kooritz & Heinz Weihrich, “Essentials of Management”, Tata McGraw-Hill, 1998.</td></tr>
<tr><td>2.</td><td colspan="8">Joseph L Massie, “Essentials of Management”, Prentice Hall of India, (Pearson) Fourth Edition, 2003.</td></tr>
<tr><td colspan="9">Reference(s):</td></tr>
<tr><td>1.</td><td colspan="8">Tripathy, P.C., Reddy, P.N., “Principles of Management”, Tata McGraw Hill, 1999.</td></tr>
<tr><td>2.</td><td colspan="8">Decenzo David, Robbin Stephen, A. “Personnel and Human Reasons Management”, Prentice Hall of India, 1996.</td></tr>
<tr><td>3.</td><td colspan="8">Stomer, J. A. F., Freeman, R. E., Danie,l R., “Gilbert Management”, Pearson Education, Sixth Edition, 2004.</td></tr>
<tr><td>4.</td><td colspan="8">Fraidoon Mazda, “Engineering Management”, Addison Wesley, 2000.</td></tr>
<tr><td>5.</td><td colspan="8">Prasad L.M. “Principles of Management”, Sultan Chand & Sons Ltd, 2003.</td></tr>
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<table>
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<tr><td colspan="2">Department</td><td colspan="2">Biotechnology</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="9">Semester VIII</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT 811</td><td>ENTREPRENEURSHIP IN BIOTECHNOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">To make the students to understand about the Biotechnology techniques, marketing of bioproducts and drugs. To create the mindset in start of Biotech companies. Learn about bioethics issues in developing and marketing biotech products to the public.</td></tr>
<tr><td>1</td><td colspan="5">OVERVIEW OF BIOTECHNOLOGY INDUSTRIES</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Scope - Biotechnology Industries in India and Abroad - Fundamentals of Biotechnology for biobusiness - Trends and keg issues in Biotechnology and devices industries - Technology basis in industry segment, emerging technologies and technical convergences issues.</td></tr>
<tr><td>2</td><td colspan="5">NEW VENTURE CREATION – ENTREPRENEURSHIP</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">Plant tissue culture lab construction – Equipment, glassware and chemical requirements - techniques in culturing of plants. Export of tissue cultured plants to aboard – Vermitechnology – Mushroom cultivation - single cell protein - Biofertilizer technology - production - Commercialization of R&D- Fermentation technology: Bakery, Dairy products.</td></tr>
<tr><td>3</td><td colspan="5">PRODUCT DEVELOPMENT</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>4</td><td colspan="5">INTELLECTUAL PROPERTY, BIOETHICS AND LEGAL ISSUES</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td>5</td><td colspan="5">BIOBUSINESS PLANS</td><td>Total Hrs</td><td colspan="2">9</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td colspan="2">45</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1</td><td colspan="8">Richard Oliver. “The coming Biotech age: The business of Biomaterials”, McGraw Hill Publications, New York, USA, 2000.</td></tr>
<tr><td>2</td><td colspan="8">Karthikeyan, S. and Arthur Ruf . “Biobusiness”. MJP Publications. Chennai, India. 2009.</td></tr>
<tr><td colspan="9">Reference(s) :</td></tr>
<tr><td>1</td><td colspan="8">Ruth Ellen Bulger. “The ethical dimensions of the Biological sciences: Cambridge University Press”. New York. 1993.</td></tr>
<tr><td>2.</td><td colspan="8">Gurinder Shahi. “BioBusiness in Asia: How countries Can Capitalize on the Life Science Revolution” Pearson Prentice Hall, 2004.</td></tr>
<tr><td>3.</td><td colspan="8">Cynthia Robbins., “The business of Biotechnology”, UK, HarperCollins, 2001.</td></tr>
</table>

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|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Semester VIII** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT 8P1 | PROJECT WORK – PHASE II | 0 | 0 | 16 | 8 | 50 | 50 | 100 |
| Objective(s) | To make the student understand the practical problem solving process in the field of Biotechnology. | | | | | | | |
| 1.<br>2.<br>3.<br>4.<br>5.<br>6.<br>7.<br>8.<br>9.<br>10. | The students must undertake the project work individually. The project work should the continuation of the project work phase-I.<br>After completion of VII semester exams this phase has to be commenced<br>The work has to be carried out in the industry<br>All the observations have to be noted down<br>Testing and analysis has to be done<br>Conclusions has to be maid<br>The phase I work has to be consolidated with phase II work<br>The project work must be made in to a bound book form<br>Appearing for viva-voce exams at the end semester | | | | | | | |
| | | | | | Total Hours | 240 | | |

| Modules | 10 HS 003 - PRINCIPLES OF MANAGEMENT<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Understanding the basic concepts of management , and to learn the contributions and functions, Types of Business organisation |
| 2. | Gaining knowledge about the various types of planning, setting objectives and forecasting |
| 3. | Exploring the difference between formal and informal organization, Knowing the various types of organization chart its structure and its process |
| 4. | Comparatively analyzing the selection process, Understanding about the concept leadership |
| 5. | Gaining knowledge about the various types of leadership |
| 6. | Evaluating the motivation theories and motivational techniques |
| 7. | Exploring the importance of communication, Learning about the process, barriers and breakdown of communication,Knowing the importance of electronic media in communication |
| 8. | Learning the different process of controlling, Understanding about the concept budgeting |
| 9. | Making a good productivity |
| 10. | Knowing the global environment, Gaining knowledge about the international |

| Modules | 10 BT 811- ENTREPRENUERSHIP IN BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Know various areas of biotechnology industries in India and abroad and the fundamentals issues related to biobusiness |
| 2. | Classify the scope of biotechnology industries based on industry segment, emerging technology and technical convergence issues |
| 3. | Develop a new venture procedures for promoting entrepreneurship in biotechnology |
| 4. | Describe the production and commercialization of fermented, dairy and bakery products |
| 5. | Design and development of alcohol, enzyme, organic acids and antibiotics and their research project management |
| 6. | Apply biotechnology knowledge for transition from Rand D to business units and Industry Institute interaction |
| 7. | Describe different types of Intellectual property rights, bioethics and current legal issues |
| 8. | Distinguish different types of transgenic bioproducts production , branding concerns and licensing procedures |
| 9. | Illustrate the business planning and financial strategies for bio-based industries and its regulatory concerns |
| 10. | Discuss the case studies types of various biotechnology industries and their strategic planning |

| Modules | 10 BT 8P1 - Project Work – Phase II<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Design the work in industrial problems and to carry out the work |
| 2. | Collected datas and information documented |
| 3. | Samples tested as per scientific techniques adapted in the literature |
| 4. | Adapt few statistical techniques for the data analysis |
| 5. | Prepare the conclusion and recommendation to the society |
| 6. | Compile all the datas as per format of thesis and communicate effectively in the viva-voce examination and to publish the paper in scientific journals and file patent |

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| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Elective I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E11 | ENVIRONMENTAL BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To develop skills of the students in the area of Environmental Biotechnology and its prerequisite for Under graduates in studies in Biotechnology. | | | | | | | |
| 1 | ENVIRONMENTAL POLLUTION | | | | Total Hrs | | 9 | |
| 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: Dissolved oxygen, Dissolved carbon-di-oxide Biological oxygen Demand, Chemical Oxygen Demand. | | | | | | | | |
| 2 | SOIL FORMATION | | | | Total Hrs | | 9 | |
| Ecosystem: Formation of soil, Physical and chemical process of soil formation, Pedogenesis, Factors affecting soil formation, Active factors for soil formation, Soil classification, Soil complex and its properties: soil organic matter, soil chemical constituents, Humus formation and importance of humic acid. | | | | | | | | |
| 3 | SOIL MICROBIOLOGY | | | | Total Hrs | | 9 | |
| Microbial flora of soil, Microbial growth, Ecological adaptations of microorgnaisms, Soil enzymes (Phosphatase, Cellulase, Urease and Dehydrogenase) and their role in nature, Soil microbial population and their importance. | | | | | | | | |
| 4 | BIODEGRADATION | | | | Total Hrs | | 9 | |
| Pesticides: effects of pesticides, pesticide degradation, Fungicides: effects of fungicides, fungicide degradation, Weedicides: effects of weedicides, weedicide degradation, DDT, Simple aromatics, Chlorinated Polyaromatic Petroleum Products-Surfactants. | | | | | | | | |
| 5 | BIOREMEDIATION | | | | Total Hrs | | 9 | |
| 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. | | | | | | | | |
| Total hours to be taught | | | | | | | 45 | |
| Text Book(s) | | | | | | | | |
| 1 | Stainer,R.Y., Ingraham J.L.,Wheelis ,M.L. and Painter.,R.R., “General Microbiology”, Mc Millan Publications, New Delhi, India,2002. | | | | | | | |
| 2 | Foster,C.f. and John Ware.,D.A., “Environmental Biotechnology”, Ellis Hon Wood Ltd., New Delhi, India, 1987. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Subba Rao, N.S. “Soil Microbiology”, Oxford and IBH Publishers Pvt. Ltd., New Delhi, India, 2004. | | | | | | | |
| 2 | Karnely,D.,Charbarty.,K., and Omen.,G.S., “Biotechnology and Biodegradation, Advances in Applied Biotechnology Series”,Vol2, Golf Publishers Co, London, UK, 1989. | | | | | | | |

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## Elective I

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E12 | MOLECULAR BIOPHYSICS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the student would have learnt about molecular structures of biological systems, cell permeability and conformation of protein and nucleic acid. This course facilitates the students to take specialization in computational biology. | | | | | | | |

| | | | |
|---|---|---|---|
| 1 | MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEM | Total Hrs | 9 |

Intra molecular bonds – covalent – ionic and hydrogen bonds – biological structures – general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

| | | | |
|---|---|---|---|
| 2 | CONFORMATION OF NUCLEIC ACID | Total Hrs | 9 |

Primary structure – the bases – sugars and phosphodiester bonds – double helical structure – the a, b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

| | | | |
|---|---|---|---|
| 3 | CONFORMATION OF PROTEINS | Total Hrs | 9 |

Conformation of the Petide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

| | | | |
|---|---|---|---|
| 4 | CELLULAR PERMEABILITY AND ION TRANSPORT | Total Hrs | 9 |

Ionic conductivity – transport across ion channels – mechanism – ion pumps – proton transfer – nerve conduction – techniques of studying ion transport and models.

| | | | |
|---|---|---|---|
| 5 | ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS | Total Hrs | 9 |

Concepts in Thermodynamics – force and motion – entropy and stability – analysis if fluxes – diffusional potential – basis properties of fluids and biomaterials – laminar and turbulent flows.

| | |
|---|---|
| Total hours to be taught | 45 |

Text book(s):


1. Glaser, R., “Biophysics” Springer Publications, London, UK, 2000.


Reference(s) :


1. Duane, R., “Biophysics: Molecules in motion”, Academic press, UK, 1999.

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| **Elective I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E13 | PRINCIPLES OF BIOMEDICAL ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, student would understand about different instruments applied in the field of medical science and its role in detection of various ailments. The course will help the students to select the applied medicinal science as their specialization. | | | | | | | |
| 1 | INTRODUCTION AND BIOINSTRUMENTATION | | | | Total Hrs | 9 | | |
| Modern health care and its evolution. Application of Engineering in Medicine. Introduction to mortality and ethics, moral norms, redefining health, terminally ill and euthanasia, human experimentation-definition, purpose, informed consent, regulation of medicine, device innovation, ethical issues, safe medical devices. Electrical Potentials in the human body. Neuromuscular system: neurons,synapses and muscles, electrical properties of nerves and muscles, problems and diagnostics. Basic bioinstrumentation systems. | | | | | | | | |
| 2 | BIOMATERIALS & BIOMECHANICS | | | | Total Hrs | 9 | | |
| Materials used to mimic/replace body functions. Basic material types and possible functions, tissue response mechanisms, invitro and invivo testing, and considerations for long term usage. Integrated design issues of multicomponent materials design in prosthetic devices for hard and soft tissues. Introduction to biomechanics. Response of living tissues to prolonged load application. Dynamics of muscle and joints. Biorheology of physiological fluids. | | | | | | | | |
| 3 | BIOPHOTONICS | | | | Total Hrs | 9 | | |
| Principles of optics and lasers in biomedicine, the interaction of light with biological tissues, optical fibers, basic circuits in fiber optic communication system, fiber optics in gastroenterology, transmission of signals, endoscope, bronchoscope, gastro scope; optical coherence tomography. Lasers in dentistry. Laser Doppler flowmetry, Optical properties of biological tissues and measurement techniques; photochemical, thermal, photoablative interaction mechanisms and their applications in photodynamic therapy; biostimulation, coagulation, vaporization, ablation, photodisruption, plasma formation, and shock wave generation; clinical applications of lasers and Laser safety. | | | | | | | | |
| 4 | MEDICAL IMAGING | | | | Total Hrs | 9 | | |
| X-rays, design considerations of X-ray tubes, projections, 3D-2D, slice identification, medical image modalities-CAT, magnetic resonance (MR) imaging, positron emission tomography (PET), single photon emission computed tomography (SPECT), computer tomography (CT), and ultrasound-underlying physical processes, signal processimg, basic imaging parameters-resolution, contrast, and noise Data acquisitions, sampling and quantization, and clinical applications. | | | | | | | | |
| 5 | BIOSENSORS | | | | Total Hrs | 9 | | |
| Biological components involved in biosensors, immobilization of biological components to transdurcers; principal performance characteristics, fabrication and biomedical applications of electrochemical, optical, piezoelectric and termistor based biosensors. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1. | Joseph D. Bronzino (ed), “The Biomedical Engineering Handbook”, Volumes I & II, CRC Press, Florida, USA, 2000. | | | | | | | |
| 2. | Enderle, J. Blanchard, S., Bronzino, J. (Eds), “Introduction to Biomedical Engineering”, Academic Press, UK, 2000. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Bushberg, J. T., Scibert, J. A., Leidholdt, E. M., Boone, J.M, “The Essential physics of medical Imaging”, Lippincott Williams and Wilkins, USA, 2002. | | | | | | | |
| 2. | Buxton, R. B., “Introduction to Functional Magnetic Resonance Imagining: Principles & Techniques”, Cambridge Univ, Press, UK, 2002. | | | | | | | |
| 3. | Fung, Y.C, “Biomechanics”, Springer - Verlag, New York, 1981. | | | | | | | |

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| Department | Biotechnology | Programme Code & Name | | BT : B.Tech Biotechnology | | | | |
| **Elective I** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E14 | FUNDAMENTALS OF IT | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To introduce the fundamentals of computer hardware and system software and to introduce basic TDBMS concepts. | | | | | | | |
| 1 | COMPUTER ARCHITECTURE AND SYSTEM SOFTWARE | | | | Total Hrs | 9 | | |
| Fundamentals of Computer Architecture – Organization of Small Computer – Execution of the Instructions – Input/output Devices – Measure of CPU Performance – Addressing modes – System Software – Assemblers – Loaders and linkers – Compilers and interpreters. | | | | | | | | |
| 2 | OPERATING SYSTEMS AND COMPUTER NETWORKS | | | | Total Hrs | 9 | | |
| Operating system – memory management – Process management – File System Management – File Permissions – New Technology File System – Device Management – Computer Networks – Motivation and need for Computer Networks – Network topology – The OSI model – Important Routing devices – Types of Networks. | | | | | | | | |
| 3 | RDBMS AND DATABASE DESIGN | | | | Total Hrs | 9 | | |
| Introduction to DBMS – data processing – the database technology – data models – RDBMS – ER modeling concept – Notations – Normalization – Need for Normalization – Process of Normalization – Types of Normal forms. | | | | | | | | |
| 4 | SQL | | | | Total Hrs | 9 | | |
| SQL – The purpose of SQL – History of SQL – Data types – Statement Types – DDL statements – DML statements – Views – DCL statements – Embedded SQL – Best Practices. | | | | | | | | |
| 5 | OLTP CONCEPTS | | | | Total Hrs | 9 | | |
| OLTP – Purpose – Transaction – Transaction Systems – Transaction Properties – Requirements for an OLTP System – Locks – Granularity of Locking – Intent Looking – Dead Lock – Time stamping – Security & Recovery Transaction log. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1 | Foundation Program Books Vol-1 and Vol-2, Infosys. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Andrew S. Tanenbaum, “Structured Computer Organization”, PHI, 3rd ed., 1991. | | | | | | | |
| 2 | Silberschatz and Galvin, Operating System Concepts, 4th ed., Addision-Wesley, 1995. | | | | | | | |
| 3 | Henry F Korth, Abraham Silberschatz, Database System Concept, 2nd edition, McGraw-Hill International editions, 1991. | | | | | | | |

| Modules | 10 BT E11- ENVIRONMENTAL BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the types and sources of air and water pollution and to determine the measures to be undergone to control pollution. |
| 2. | Identify the mechanism of acid rain and the effect of dissolved oxygen, dissolved carbon-di- oxide. |
| 3. | Understand the physical and chemical process of soil formation and the factors affecting it. |
| 4. | Describe the size and performance of individual components of the ecosystem like soil organic matter, soil chemical constituents and humus formation. |
| 5. | Outline the various types of soil microbes and their growth and ecological adaptability. |
| 6. | Discuss the importance of soil microbes and their enzyme activity such as phosphatase, cellulase, urease and dehydrogenase. |
| 7. | Explain the consequence of pesticides and its degradation pathways |
| 8. | Illustrate the action, effect of fungicides and weedicides such as DDT, simple aromatics, chlorinated polyaromatic petroleum products and surfactants. |
| 9. | Appraise the use of microbes and plants in bioremediation of oil spilled and salt affected soils along with the usage of biofertilizers for poor soil management. |
| 10. | Summarize the role of biological indicators and solid waste management of dairy, pulp |

| Modules | 10 BT E12 - MOLECULAR BIOPHYSICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the nature of intramolecular bonding in biomolecules along with the structure of water |
| 2. | Demonstrate the mode of self assembly and the molecular structure of the biological membranes. |
| 3. | Illustrate the primitive concepts in the fine structure of nucleic acids including their forms, the nature of bases, sugar and phosphodiester bonds |
| 4. | Outline the basic topology of dna and the role of polymorphism and flexibility of dna |
| 5. | Describe the structural conformation of proteins and validate the protein structures using ramachandran plot |
| 6. | Outline the folding nature of proteins and the principle behind hydration and hydropathy index of proteins |
| 7. | Describe the mechanism behind transportation across ion channels along with ion pumps and proton transfer |
| 8. | Demonstrate the process behind nerve conduction and study the ion transport and their models using various techniques |
| 9. | Discuss the concepts in thermodynamics with special reference to entropy and stability |
| 10. | Illustrate the basic nature of fluids and biomaterials along with laminar and turbulent flows |

| Modules | 10 BT E13 - PRINCIPLES OF BIOMEDICAL ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the ethics and requirement for human experimentation. |
| 2. | Demonstrate the anatomy, mechanism and diagnosis of Neuromuscular system. |
| 3. | Deduce the basic material types, function, mechanism of tissue response and materials used to mimic body functions. |
| 4. | Illustrate the importance of biomechanics and biorheology of physiological fluids. |
| 5. | Define the principle and applications of biophotonics in endoscope, bronchoscope and gastroscope |
| 6. | Interpret the clinical diagnosis of photodynamic therapy and laser safety. |
| 7. | Understand the mechanism of medical imaging techniques such as CAT, MR, SPECT and CT in clinical applications. |
| 8. | Infer the image quality by adjusting the parameters. |
| 9. | Elucidate the working principle of biosensors and transducers. |
| 10. | Enumerate the fabrication and biomedical application of different types of biosensors |

| Modules | 10 BT E14 - FUNDAMENTALS OF IT<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Point out the specification of instructions and how the hardware unit implements those instructions. |
| 2. | List the various system software and their application. |
| 3. | Explore the various operating system and its functions. |
| 4. | Categorize the OSI layer and types of networks. |
| 5. | Analyze the various data models such as E-R model, relational model, etc.. |
| 6. | Design a data base using various normal forms. |
| 7. | List the purpose of SQL. |
| 8. | Define the concepts of data manipulation language, data definition language, data control language and data transaction language and applying queries for retrieving data from the database. |
| 9. | Explain the data transaction concepts with transaction properties. |
| 10. | Point out the various locking methods. |

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## Elective II

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E21 | IMMUNOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | To develop the skills of the students in the area of immunotechnology pre-requesting for PG studies in biotechnology and related fields. At the end of the course the student would have learnt various techniques like developing diagnostic tests, characterization of lymphocytes, purification of antigens, antibody engineering etc. |
|---|---|

| 1 | INTRODUCTION | Total Hrs | 9 |
|---|---|---|---|

Immunogens and antigens- Classification of the immune response: Innate: Role of inflammatory cells, acquired immunity and its components. Adjuvants and their mode of action.

| 2 | IMMUNODIAGNOSIS | Total Hrs | 9 |
|---|---|---|---|

Western blot analysis, immuno electrophorosis, SDS- PAGE, purification and synthesis of antigens. ELISA- principle and applications. Principles and applications of Radio Immuno Assay (RIA), Immunochromatography.

| 3 | IMMUNOPATHOLOGY | Total Hrs | 9 |
|---|---|---|---|

Preparation and storage of tissues, identification of various cell types and antigens in tissues. Isolation and characterization of cell types from inflammatory site and infected tissues. Immunocytochemistry- immuno fluorescence, immuno enzymatic and immuno ferrtin techniques and immunoelectron microscopy.

| 4 | MOLECULAR IMMUNOLOGY | Total Hrs | 9 |
|---|---|---|---|

Vaccine Types,Preparation of vaccines, application of recombinant DNA technology for the study of the immune system, production of antidiotypic antibodies, catalytic antibodies, application of PCR technology to produce antibodies and other immunological reagents, immuno therapy with genetically engineered antibodies.

| 5 | TECHNIQUES IN IMMUNOTECHNOLOGY | Total Hrs | 9 |
|---|---|---|---|

Trends in immunology of infectious diseases and tumours. Antigen- antibody interactions, Isolation of pure antibody, assays of circulating immune complexes. Isolation of lymphocyte populations.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :


1. Roitt, I. Brostoff, J. and David, M. “Immunology”, 6th Edn. Mosby publishers Ltd., USA. 2001.
2. Talwar, G. P. and Gupta S. K. A “Hand book of practical and clinical immunology” Vol. I &II. CSB Publications, New Delhi, 1992.


Reference(s) :


1. Kuby,J .H. Immunology, 5th Edn. W. H. Freeman Publication USA. 2002.
2. Tizard, R.I. Immunology, 4 th Edn. Saunders college Publishing, USA. 2004.

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| **Elective II** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E22 | MARINE BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course the students should have enough knowledge about the Marine microbes, Aquatic animals and biomedical importance of marine organisms. | | | | | | | |
| 1 | INTRODUCTION TO MARINE MICROBES IN THE OCEAN | | | | Total Hrs | 9 | | |
| Marine microbial diversity - Criterion Habitats -Presence of other organisms:Symbiotic, Free-living, Biofilm, Proximity to the ocean surface or sediments :Euphotic -Mesopelagic - Bathopelagic - Benthos (sediments)- Concentration of nutrients and required growth substrates: Oligotrophic, Mesotrophic , Eutrophic - interactions between marine microbes: symbiosis and pathogenesis: the abundance and distribution of bacterial and viral pathogens - Metabolic capabilities of marine microbes: adapting to extreme environments - Algal blooms- marine bacteria. Applying marine microbes using biotechnology: industrial applications, energy production, medical applications, using marine microbes to meliorate environmental deterioration. | | | | | | | | |
| 2 | BIOTECHNOLOGY OF AQUATIC ANIMALS | | | | Total Hrs | 9 | | |
| Shellfish and Crustacean Culture; Aquaculture- shrimps, edible mussels, pearl oyster, crabs;Fish Physiology - reproductive genetics: gynogenesis$_v$ androgensis, polyploidy, control of sex,artificial insemination, eye stalk ablation - Development of Healthy Fish Diets, Disease Prevention in Fish, and .GM fish and shellfish- Disease resistance in marine animals and DNA Vaccine development for aquacultured fish - gene banks, cryopreservation. Isolation and characterization of biosynthetic gene clusters, the cloning and expression of the genes in recombinant systems, mariculture and aquaculture of marine invertebrates such as bryozoans, sponges, and tunicates.Isolation, cultivation and fermentation of microorganisms from their invertebrate hosts. | | | | | | | | |
| 3 | BIOMEDICAL IMPORTANCE OF MARINE ORGANISMS | | | | Total Hrs | 9 | | |
| Seafood Allergy: Clinical Symptoms, Immunological Mechanisms and Molecular Biology Marine Pharmacology: Pharmaceutical and Bioactive Natural Products -Microalgae as a Source of Bioactive Molecules- New Antibiotics and Medicines from Marine Organisms- Potentialities in theTreatment of Infectious Diseases, Osteoporosis and Alzheimer's Disease Cyanobacterial Biotechnology -The Secondary Metabolites and Biosynthetic Gene Clusters of Marine Cyanobacteria.- Applications in Biotechnology - Secondary Metabolites From Marine-derived Fungi and Probiotics. | | | | | | | | |
| 4 | BIOMATERIALS AND BIOPROCESSING | | | | Total Hrs | 9 | | |
| Polymers & biomaterials: agarose, agar, alginates, carrageaas, chitin, chitosan, carotene, heparin,marine flavourants - environmentally friendly antifouling compounds Biopotential uses of halophilic organisms. Role of halophilic bacteria and artemia in salt purification. | | | | | | | | |
| 5 | ENVIRONMENTAL IMPACTS OF AQUATIC BIOTECHNOLOGY | | | | Total Hrs | 9 | | |
| Control of oil spills and bioremediation - viral therapy. -Genetically Engineered Marine Organisms : Environmental and Economic Risks and Benefits | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1 | Attaway, D. H., Zaborsky, 0. R. (Ed.). Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products. New York, USA, 1993. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1 | Weber, P. "Abandoned seas: Reversing the decline" World Watch. Paper 116, November, 1993, p.5 | | | | | | | |
| 2 | Powers, D. A. "New frontiers in marine biotechnology: Opportunities for the 21st century." In: Marine Biotechnology in the Asian Pacific Region (eds). C. G. Lundin and R. A. Zilinskas. The World Bank and SIDA. Stockholm, Sweeden, 1995. | | | | | | | |

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## Elective II

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E23 | METABOLIC ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course, the student would have learnt about Biosynthesis of primary & secondary metabolites, Bioconversion etc and its relevance to Industrial applications. |
|---|---|

| 1 | INTRODUCTION | Total Hrs | 9 |
|---|---|---|---|

Induction-jacob monod model, catabolite regulation, glucose effect, camp deficiency, feedback regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feedback regulation, cumulative feedback regulation, amnio acid regulation of rna synthesis, energy charge, regulation, amino acid regulation of rna synthesis, energy charge, regulation, premeability control passive diffusion, active transport group transportation.

| 2 | SYNTHESIS OF PRIMARY METABOLITES | Total Hrs | 9 |
|---|---|---|---|

Alteration of feedback regulation, limiting accumulation of end products, feedback, resistant mutants, alteration of permeability, metabolites.

| 3 | BIOSYNTHESIS OF SECONDARY METABOLITES | Total Hrs | 9 |
|---|---|---|---|

Precursor effects, prophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

| 4 | BIOCONVERSIONS | Total Hrs | 9 |
|---|---|---|---|

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

| 5 | REGULATION OF ENZYME PRODUCTION | Total Hrs | 9 |
|---|---|---|---|

Strain selection, improving fermentation, recognising growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :

| 1 | Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnil, P, Humphery, A.E., Lilly, M.D. “Fermentation And Enzyme Technology”, John Wiley And Sons. 1980. |
|---|---|
| 2 | Stanbury, P.F., And Whitaker A., “Principles of Fermentation Technology”, Pergamon Press, 1984. |

Reference(s) **:**

| 1 | Zubay, G., "Biochemistry ", Macmillan Publishers, 1989. |
|---|---|

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## Elective II

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E24 | BASICS OF STEM CELLS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the students will have enough knowledge about the stem cell research methodologies. |
|---|---|

| 1 | ORIGIN OF HUMAN STEM CELLS | Total Hrs | 9 |
|---|---|---|---|

Embryogenesis, Definition and differentiation of stem cells, Origin and characterisation of human stem cells and potential applications for stem cell research. Plasticity of human somatic stem cells. Sources of stem cells, cord blood. Scientific and technical obstacles to overcome before realising the potential clinical use of novel human stem cell based therapy, Identifying stem cells- stem cell marker.

| 2 | HUMAN EMBROYONIC STEM CELL RESEARCH | Total Hrs | 9 |
|---|---|---|---|

Possible sources for human embryonic stem cells, Growing human ESC in laboratory, Current advantages and limitations of hESC and human somatic cells, Examination the need for new cell lines, Developments regarding establishment of human stem cell banks and registries. Government of hESC research, Ethical issues at stake, Regulations in European member states and Non European countries regarding human ESC research.

| 3 | PROTOCOLS FOR ISOLATION AND IDENTIFICATION OF NEURAL STEM CELLS | Total Hrs | 9 |
|---|---|---|---|

Neural diseases, Preparation of complete neuroculture, culturing and subculturing human neurospheres, Differentiation of cells from human, neurospheres into neurons, astocytes and oligodentrocytes; Immuno-labeling procedure.

| 4 | STEM CELL THERAPY | Total Hrs | 9 |
|---|---|---|---|

Novel stem cell based therapies, Possibilities to overcome immuno-rejection in stem cell therapy, Haematopoietic stem cell transplantation-A new therapy for autoimmune disease, Prenatal diagnosis of genetic abnormalities using fetal CD34+ stem cells. Stem cells in treatment for major disease and reparative medicine, ESC a promising tool for Parkinson's disease and arthritis.

| 5 | TISSUE ENGINEERING | Total Hrs | 9 |
|---|---|---|---|

Basic principles and consideration- cell type and source, metabolic requirements of cells, reconstruction of connective tissues, reconstruction of epithelial or endothelial surfaces- cells embedded in extracellular matrix material, culture on a single surface and sandwich configuration, bioreactor design on tissue engineering- hollow fibre systems, Microcarrier based systems, tissue engineering of the liver.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :


| 1 | John R.W. Master, "Animal cell culture - A practical approach", Oxford University Press, UK, 2004. |
|---|---|


Reference(s) :


| 1 | Bernhard Palsson, Jeffery A.Hubble, Robert P.Lonsey, and Joseph D. Bronzino "Tissue engineering, Principles and applications in engineering" CRC press, UK, 2005. |
|---|---|
| 2 | Deb,K.D ant Totey, S.M. "Stem cells basics and applications", Tata Mc Graw Hill Education Pvt. Ltd. New Delhi, 2009. |

| Modules | 10 BT E21 - IMMUNOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Classify the immune responses and distinguish immunogens and antigens. |
| 2. | Describe the role of inflammatory cells in innate immunity and adjuvants mode of action. |
| 3. | Determine the pathogenicity using SDS-PAGE, Western blotting, immunoelectrophoresis, ELISA and Radio immuno assay. |
| 4. | Explain the synthesis of antigen and purification of antigen using immunochromatography. |
| 5. | Prepare the tissue for the identification of various cells and antigens from inflammatory site. |
| 6. | Identify the pathology using immuno fluorescence, immuno enzymatic and immuno ferrtin techniques. |
| 7. | Define the types of vaccines and application of r-DNA and PCR technology in the production of vaccines and antibodies. |
| 8. | Deduce the application of immuno therapy with genetically engineered antibodies. |
| 9. | Analyze the immunity developed against bacteria, fungi, virus, parasite and tumors. |
| 10. | Demonstrate the mechanism of antigen- antibody interaction and isolation of pure antibody and lymphocyte populations |

| Modules | 10 BT E22 – MARINE BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Explain the different habitats of marine biodiversity and its nutrient and growth requirements |
| 2. | Illustrate the interactions between marine microbes, metabolic capabilities and adaptability to extreme environments. |
| 3. | Describe aquaculture, fish physiology, reproductive genetics, control of sex, artificial insemination, eye stalk ablation |
| 4. | Explain the development of fish diets, disease management and development of dna vaccine. |
| 5. | Define and illustrate the sea food allergy, clinical symptoms, immunological and molecular mechanisms of marine pharmacology. |
| 6. | Describe the use of bioactive compounds of the marine natural products obtained from different marine organisms and its potentialities in treatment of infectious diseases . |
| 7. | Identify the marine sources that produces polymers and biomaterials like agar, agarose, alginates, chitin, chitosan,heparin . |
| 8. | Explain mechanism of antifouling compounds, biopotential uses of halophilic bacteria and artemia in salt purification. |
| 9. | Interpret the control of oil spills and bioremediation using microbes. |
| 10. | Describe the engineering of marine natural products its environmental risks and benefits . |

| Modules | 10BT E23 - METABOLIC ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Outline amino acid regulation of RNA synthesis |
| 2. | Derive the Jacob monod model and regulation in branched pathways. |
| 3. | Explain alteration of feedback regulation and limiting accumulation of end products. |
| 4. | Describe alteration of permeability and metabolites. |
| 5. | Elucidate precursor effects, iodophase relationship and enzyme induction. |
| 6. | Illustrate catabolite regulation by passing control of secondary metabolism. |
| 7. | Describe bioconversion and factors influenzing bioconversion with their advantages. |
| 8. | Explain bioconversion achieved for insoluble substances and mixed or sequential bioconversion. |
| 9. | Design feedback repression and catabolite repression. |
| 10. | Analyze how microbial fermentation is attained by growth cycle and steps to improve fermentation process |

| Modules | 10 BT E24 – BASICS OF STEM CELLS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Summarize the process of embryogenesis in humans and the differentiation of stem cells. |
| 2. | Discuss the various types, sources, characterization and plasticity of stem cells. |
| 3. | Identify the aseptic conditions for growing embryonic stem cells in laboratory and the ethical issues related to stem cell usage. |
| 4. | Comprehend the need and use of stem cell banks and registries and regulations in european and non european countries. |
| 5. | Outline a flowchart illustrating the steps involved in isolation of neural cells the steps involved in immunolabeling process. |
| 6. | Sequence the steps involved in culturing and sub culturing neurospheres and its differentiation into neurons, astrocytes and oligodentrocytes. |
| 7. | Assess immuno rejection process and the steps to overcome it through haematopoietic stem cell transplantation. |
| 8. | Summarize how stem cells are used to diagnosis genetic abnormalities using fetal cd34+ stem cells and cure parkinson’s disease and arthritis. |
| 9. | Compile the basic principles of tissue engineering and metabolic requirements of cells and steps involved in engineering a skin. |
| 10. | Summarize the applications of microcarriers and design a bioreactor for tissue engineering of liver. |

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## Elective III

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E31 | GENOMICS AND PROTEOMICS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the students should have the knowledge of the Genome sequence, Functional Genomics, proteomics and about the tools for proteomics. |
|---|---|

| 1 | STRUCTURAL GENOMICS | Total Hrs | 9 |
|---|---|---|---|

Overview of genome; Genome sequence acquisition and analysis; comparative homologies, evolutionary changes; SNPs; Genetic analysis: Linkage mapping and analysis; High resolution chromosome maps; Physical mapping, YAC, BAC, Hybrid mapping strategies, microarrays; Sequence specific tags (SST), Sequence-tagged sites(STS), ISH, FISH, RFLP and RAPD.

| 2 | DNA SEQUENCING | Total Hrs | 9 |
|---|---|---|---|

Variations in sequencing methods: Ladder, Fluorescent, Mass Spectrometry, Shotgun, Transposon-mediated, etc); Automation Sequencing; Finding genes and mutations; Implications of DNA sequencing; Implications of sequencing genomes.

| 3 | FUNCTIONAL GENOMICS | Total Hrs | 9 |
|---|---|---|---|

Construction and screening of cDNA libraries; PCR: variations in PCR; cDNA microarrays, gene disruptions, Yeast two-hybrid system, serial analysis of gene expression (SAGE), SAGE Adaptation for Downsized Extracts (SADE); applications of DNA arrays, Pharmacogenomics.

| 4 | PROTEOMICS | Total Hrs | 9 |
|---|---|---|---|

Overview of sequence analysis: Databases, datamining, Sequence alignment; Algorithms in proteomics, Applications of Proteomics: proteome mining, protein expression profiling, protein-protein interactions, protein modifications; automation.

| 5 | TOOLS FOR PROTEOMICS | Total Hrs | 9 |
|---|---|---|---|

2D Electrophoresis, IEF, HPLC, Protein digestion techniques; Mass Spectrophotometry: MALDI-TOF, Mass analyzers, Peptide Mass Fingerprinting; protein arrays.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :

| 1 | Liebler, DC, “Introduction to Proteomics, Tools for the new biology”, Humana Press, UK, 2002. |
|---|---|
| 2 | Hunt, SP, Livesey FJ, “Functional Genomics”, Oxford University Press,UK, 2000. |

Reference(s) :

| 1 | Cantor, CR, “Genomics”, John Wiley,London, UK, 1999. |
|---|---|
| 2 | Westermier, R, Naven T, “Proteomics in practice, A laboratory manual of proteome analysis”, John Wiley-VCH, UK, 2002. |

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| **Elective III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E32 | NANOSCIENCE AND TECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | At the end of the course, the students would have gained extensive knowledge in Nanobiotechnology, involvement macromolecules in nanobiotechnology, application in drug delivery, cancer treatment. | | | | | | | |
| 1 | INTRODUCTION TO NANOBIOTECHNOLOGY | | | | Total Hrs | | 9 | |
| Introduction to nanobiotechnology-micro and nanosystems and technologies; overview of nanodevices and techniques. Synthesis and characterization of nanoscale materials- stratergies for nanoarchitecture (topdown and bottom up approaches) - fabrication technologies and characterization – self assembly systems. | | | | | | | | |
| 2 | SYNTHESIS OF NANOPARTICLES | | | | Total Hrs | | 9 | |
| Inorganic nanoscale systems for biosystems-nanostructure materials –fullerness: properties and characterization – carbon nano tubes: characterization and application-quantum dots and wires. Synthesis of gold, silver and silica nanoparticles – nanopores. | | | | | | | | |
| 3 | NANOMOLECULES IN BIOSYSTEMS | | | | Total Hrs | | 9 | |
| Nanomolecules in biosystems-proteins, lipids,RNA and DNA-nanoscale elements for delivery of materials into cells- peptide coupled nanoparticles – DNA based artificial nanostructures – proteins as components in nanodevices, lipids in self assembly structures. | | | | | | | | |
| 4 | USE OF MICROORGANISMS IN NANOBIOTECHNOLOGY | | | | Total Hrs | | 9 | |
| Nanobiotechnology and Microorganisms –PHA in nanobiotechnology –cyaophycin inclusions-magnetosomes- alignates- bacteriophages-bacterial spores-bacterial protein complexes-s-layer proteins-bacteriorhodopsin. | | | | | | | | |
| 5 | APPLICATION OF NANOBIOTECHNOLOGY | | | | Total Hrs. | | 9 | |
| Nanobiotechnology in drug delivery-nanoscale devices for drug delivery-micelles for drug delivery –protein targeting: small molecules-protein interactions-microarray and genome chips-nanobiosensors and nanobiochips. Nanotechnology for cancer diagnosis and treatment. Nanobiotechnology for cell destruction. | | | | | | | | |
| Total Hours Taught | | | | | | | | 45 |
| Text book (s) : | | | | | | | | |
| 1 | Jain, K.K., “Nanobiotechnology in molecular diagnostics –current techniques and applications” Taylor Publications, New Delhi, India, 2006. | | | | | | | |
| Reference**(**s) : | | | | | | | | |
| 1 | Salata, O.V. Journal of Nanobiotechnology, (), 2:3. Applications of Nanoparticles in biology and medicine, 2004. | | | | | | | |
| 2 | CM.Niemeyer and CA Mirkin.Nanobiotechnology – concepts, Applications and perspectives. | | | | | | | |

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## Elective III

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E33 | CANCER BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course, the student would have learnt about pathogenesis of cancer, identifications of cancer through tools developed by biotechnology research & molecules synthesized for cancer therapy. This will be very beneficial for the student to take up projects in Cancer Biology. |
|---|---|

| 1 | FUNDAMENTALS OF CANCER BIOLOGY | Total Hrs | 9 |
|---|---|---|---|

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

| 2 | PRINCIPLES OF CARCINOGENESIS | Total Hrs | 9 |
|---|---|---|---|

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

| 3 | PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER | Total Hrs | 9 |
|---|---|---|---|

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

| 4 | PRINCIPLES OF CANCER METASTASIS | Total Hrs | 9 |
|---|---|---|---|

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

| 5 | NEW MOLECULES FOR CANCER THERAPY | Total Hrs | 9 |
|---|---|---|---|

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :

| 1 | Maly, B.W.J., “Virology A Practical Approach”, IRLl Press, Oxford, UK, 1987. |
|---|---|
| 2 | Dunmock, N.J. and Primrose S.B., “Introduction to Modern Virology”, Blackwell Scientific Publications, Oxford, UK, 1988. |

Reference(s) :

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

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| **Elective III** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E34 | IT ESSENTIALS | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To introduce and various essential concepts of IT | | | | | | | |

| | | | |
|---|---|---|---|
| 1 | ANALYSIS OF ALGORITHMS | Total Hrs | 9 |
| Introduction of ADA – Code Tuning Techniques – Analysis of Algorithms – Analysis of Some Known Algorithms – Algorithmic Techniques – Linear search – Binary search – Bubble sort – Quick sort – Merge sort – Selection sort – Insertion sort – Intractable Problems. | | | |
| 2 | OBJECT ORIENTED CONCEPTS | Total Hrs | 9 |
| Introduction to Object oriented concepts – Advanced concepts in Object oriented technology – relationship – Inheritance – Abstract classes – Polymorphism – Object oriented design methodology – Recent trends in OO Technology. | | | |
| 3 | SYSTEM DEVELOPMENT METHODOLOGY | Total Hrs | 9 |
| System Development Methodology – Evolution of Software – Software Development Models – Requirement Analysis and Design – Software Construction – Software Testing – Software Quality. | | | |
| 4 | CLIENT SERVER CONCEPTS | Total Hrs | 9 |
| Client server computing – Back Ground – Client Server Technologies – Middle ware technologies – Introduction to Web Technology. | | | |
| 5 | WEB TECHNOLOGIES & USER INTERFACE DESIGN | Total Hrs | 9 |
| The world wide web – Web Application – Security in Applications – issues in web based application – Introduction to User interface Design (UID) – The elements of UID –UID Tips and techniques – Good Vs Bad<br>User Interface – Reports. | | | |
| Total hours to be taught | | | 45 |

Text book (s) :

| | |
|---|---|
| 1 | Foundation Program Books Vol-2 and Vol-3, Infosys. |

Reference(s) :


| | |
|---|---|
| 1 | Brad J.Cox, Andrew J.Novobilski, Object Oriented Programming – An evolutionary approach, Addison Wesley, 1991 |
| 2 | Alfred V.Aho, John E.Hopcroft, Jeffrey D.Ullman, Design and Analysis of Computer Algorithms, Addison Wesley Publishing Co., 1998 |
| 3 | Rojer Pressman, Software Engineering-A Practitioners approach, McGraw Hill, 5th Edition, 2001 |
| 4 | Wilbert O.Galitz, Essential Guide to User Interface Design, John Wiley, 1997 |
| 5 | Alex Berson, Client server Architecture, Mc Grew Hill International, 1994 |
| 6 | Dromey R.G., How to solve it by Computers, PHI, 1994 |

| Modules | 10 BT E31 - GENOMICS AND PROTEOMICS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Acquire knowledge on genome sequence and structure through genetic mapping and analysis |
| 2. | Determine the position of genes on a chromosome using molecular markers such as sts, sst, rapd, rflp and its expression through microarray |
| 3. | Determine the precise order of nucleotides by chemical and automated sequencing method |
| 4. | Describe the method of predicting of mutations and gene functions |
| 5. | Amplify the dna using various pcr techniques and the method of constructing and screening dna libraries |
| 6. | Analyze the information of gene expression through sage and sade |
| 7. | Determine the similarity among the protein sequences and mine the data from different database |
| 8. | Identify the expressed proteins and probe the interaction among proteins and ligands |
| 9. | Illustrate and analyze the proteins with reference to 2d electrophoresis, ief |
| 10. | Characterize the individual molecules based on their mass by mass spectrophotometry and maldi-tof and protein mass fingerprinting |

| Modules | 10 BT E32 - NANO SCIENCE AND TECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Know the basic concepts in nanobiotechnology and the systems used in nano electronics and microelectronics. |
| 2. | Synthesize and characterize different types of nanoparticles and stratergies for top down and bottom up method |
| 3. | Describe the synthesis of carbon nanotubes ,quantum dots and fullernes |
| 4. | Understand the mechanism of synthesizing gold, silver and silica nanoparticles from microorganisms |
| 5. | Illustrate the mechanism of lipids as nanobricks and nanomortars and its self organizing supramolecular structure. |
| 6. | Explain the role of, dna based artificial nanostructure , protein components and lipid self assembly. |
| 7. | Describe the role of s layer proteins application of pha, cyanophycin, magnetosomes in the application of nanotechnology. |
| 8. | Understand the role of s layer proteins ,bacterial protein complexes and bacterial spores |
| 9. | Apply various nanoscale devices such as microarray, nanobiosensors and biochips for drug delivery systems . |
| 10. | Utilize and apply nanotechnology for cancer diagnosis and treatment and biocontrol agents in plants |

| Modules | 10 BT E33 - CANCER BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | **At the end of the course, the student will be able to** |
| 1. | Describe, differentiation and application of the knowledge on modulation of cell cycle in cancer. |
| 2. | Identify the types of cancer cells using biochemical assays. |
| 3. | Analyze and interpret the scientific theory of carcinogenesis. |
| 4. | Elucidate the mechanism of x-radiation carcinogenesis. |
| 5. | Illustrate the importance of signal targets and activation of kinases in cancer. |
| 6. | Explain the growth and developmental factors involved in the transformation of cancer cells. |
| 7. | Determine the importance and clinical significances of invasion in metastasis. |
| 8. | Design and develop the structural characteristics of basement membrane disruption. |
| 9. | Recognize and classify the different forms of cancer therapeutic agents. |
| 10. | Understand the significance, importance and real time problems of signal targets in cancer therapy. |

| Modules | 10 BT E34 - IT ESSENTIALS<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the fundamental concepts of procedural programming and object-oriented programming. |
| 2. | Discover the fundamental properties of algorithmic techniques and its types. |
| 3. | Explain the concept of intractability in a given problem. |
| 4. | Recognize the basics concepts of inheritance, polymorphism, abstract classes, classes, their member variables, methods and interfaces. |
| 5. | Realize the problems in software development and the evolution of software. |
| 6. | Identify the fundamental functions of software development life cycle models recognize the different approaches to testing, test plan design and execution. |
| 7. | List the quality concepts, International Quality Standard and Capability Maturity Model. |
| 8. | Discover the fundamental concepts of client server model with host centric and isolated computing model. |
| 9. | Point out the fundamental concepts of web technology, networking, internet and world wide web. |
| 10. | Discover the user interface issues in software development and identify the user interface design techniques |

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## Elective IV

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E41 | TISSUE ENGINEERING | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the students will have enough knowledge of tissue engineering. The course will useful to the student for opting higher studies. |
|---|---|

| 1 | INTRODUCTION TO TISSUE ENGINEERING | Total Hrs | 9 |
|---|---|---|---|

History and scope of tissue engineering-basic definition-scientific challenges, general scientific issues; Tissue engineering in perspectives-origin, triad, acellular prosthesis. Equipments and materials for animal cell culture technology.

| 2 | STRUCTURE AND ORGANIZATION OF TISSUES: | Total Hrs | 9 |
|---|---|---|---|

Vascularisation of *in vitro* and *in vivo* – organization of cells into higher ordered structures-stimuli of the transformation, dynamics of cell- ECM interaction-composition and delivery of ECM,receptors for extracellular matrix molecules and basic developmental biology.

| 3 | TRANSPORT PROPERTIES OF TISSUES | Total Hrs | 9 |
|---|---|---|---|

Introduction to mass transfer, Diffusion of simple metabolites, Diffusion and reaction of proteins-transport in tissue engineering-molecular interaction with cells, molecular and cell transport through tissues.

| 4 | GENERAL ASPECTS OF CELLS IN CULTURE | Total Hrs | 9 |
|---|---|---|---|

Transport limits on 3D cultures, Cell-Matrix & Cell-Cell Interactions, cell migration and control of cell migration,Differential cell adhesion & tissue organization, Hormone & Growth Factor Signaling, Growth factor delivery in tissue engineering, Scaffolds *&* tissue engineering - Basic properties, Basic transplantation immunology, Quantitative analysis of receptor-ligand binding, Applications of growth factors: VEGF/angiogenesis.

| 5 | STEM CELLS | Total Hrs | 9 |
|---|---|---|---|

Introduction, Hematopoiesis, Stem cells & bone , ES cells, Cell surface markers, FACS analysis, Basic wound healing, Introduction to liver pathophysiology, Cell transplantation for liver tissue engineering. *In vitro* organogenesis, Physiological models.

| Total hours to be taught | 45 |
|---|---|

Text book (s) :

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

Reference(s) :

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

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## Elective IV

| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CA | ES | Total |
| 10 BT E42 | CLINICAL TRIAL MANAGEMENT | 3 | 0 | 0 | 3 | 50 | 50 | 100 |

| Objective(s) | At the end of the course the students will have a complete knowledge of Ethical guidelines, clinical trials and clinical researches. |
|---|---|

| 1 | ETHICAL GUIDELINES | Total Hrs | 9 |
|---|---|---|---|

Ethical Guidelines for Biomedical Research on Human guidelines – student of specific principles for chemical evaluation – Human Genome project - DNA banking – prenatal diagnosis – principles in transplantation.

| 2 | APPLICATIONS OF STATISTICS AND PROBABILITY | Total Hrs | 9 |
|---|---|---|---|

Applications of Biostatics in clinical Trial Management: Correlation - simple linear regression – multiple regression – T-test - F-test – Chi square test - ANOVA – One way ANOVA.

| 3 | CONTRACT RESEARCHES | Total Hrs | 9 |
|---|---|---|---|

Contract research – delivery model – CR Business environment – CR Information research – Contract research – Regulatory affairs of contract research – Clinical trial environment.

| 4 | CILNICAL TRIALS OUT SOURCING | Total Hrs | 9 |
|---|---|---|---|

Clinical trial – protocol approval – Informed consent – responsibility of sponsor – investigator – ethics committee – types of clinical trials – structure & contents of clinical report. Data blinding & Randomization – data management – trial subjects recruiting.

| 5 | OUTSOURCING TRENDS-CASE STUDY OF MEDICAL CODING | Total Hrs | 9 |
|---|---|---|---|

Introduction of medical coding and billing – Role of International classification of diseases book in medical coding- CPT (Current Procedure Terminology codes)-HIPAA (Health information portability and accounting act) - HCPCS (Healthcare Common Procedure Coding System)-CPC(Certified Professional Coder) –Medical billing and medical transcription-Medical coding job market in Business Process Outsourcing (BPO's) companies-starting own business sectors of medical coding and billing.

| Total Hours Taught | 45 |
|---|---|

Text book (s) :


1. ICMR, "Ethical guidelines for biological research on human subjects", Indian council of Medical Research Press, New Delhi, 2000.
2. 2012 International Classification of Diseases (ICD)- 10-CM, code Book diagnoses code set to assist in ICD- 10 training and code clarification, Tata Mc Graw Hill, New York, USA, 2012.


Reference**(**s) :


1. The drug and cosmetic rule. Schedule Y., "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.

<table>
<tr><td colspan="7">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Biotechnology</td><td>Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="8">Elective IV</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT E43</td><td>SYSTEMS BIOLOGY</td><td>3</td><td>0</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="6">To provide basic and advanced information about Medical coding, phylogenetics and its analysis. To educate the students about the methods and comparative analysis</td></tr>
<tr><td>1</td><td colspan="4">HUMAN PHYSIOLOGY,ANATOMY AND PATHOLOGY</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Human Nutrition- Digestive system-Respiratory system-Circulatory system-Central Nervous system- Autonomous nervous system-Endocrine System-Reproductive System- Integumentary system- Outline of ENT (Ear,Nose,Throat)-Human skeleton System.</td></tr>
<tr><td>2</td><td colspan="4">MEDICAL CODING AND BILLING</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Medical coding and Billing introduction-ICD (International classification of diseases)-CPT (Current Procedure Terminology codes)-HIPAA (Health information portability and accounting act)- HCPCS (Healthcare Common Procedure Coding System)- CPC(Certified Professional Coder) – CPC-H (Certified Professional Coder-Hospital)- CPC-P (Certified Professional Coder-Payer)- CPC-P-A(Certified Professional Coder-Payer-Apprentice)- Difference between medical coding, Medical billing and medical transcription-Medical coding job market in Business Process Outsourcing (BPO‘s) companies-Starting own business sectors of medical coding and billing.</td></tr>
<tr><td>3</td><td colspan="4">C-LANGUAGE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">Introduction to C language - Constants, Variables, Data types; Operators and Expression, Decision Making and Branching; Looping; Arrays- Strings; User defined functions; Storage Classes- Structures and Unions; Functions; Pointers;</td></tr>
<tr><td>4</td><td colspan="4">C++ LANGUAGE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">C++ fundamentals; Function overloading; Classes and Objects; Friend functions; Static data and member functions- Constructors – Parameterized, Dynamic, Copy; Destructors; Dynamic Objects; Pointers to Objects; Operator Overloading; Inheritance; Virtual functions,</td></tr>
<tr><td>5</td><td colspan="4">SOFTWARE APPLICATIONS OF C AND C++ LANGUAGE</td><td colspan="2">Total Hrs</td><td>9</td></tr>
<tr><td colspan="8">File Management in C and C++ language- Applications of C language in System Biology, Applications of C ++ language in System Biology, case studies, system biology testing softwares.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>45</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="7">2012 International Classification of Diseases (ICD)- 10-CM, code Book diagnoses code set to assist in ICD- 10 training and code clarification, Tata Mc Graw Hill, New York, USA, 2012.</td></tr>
<tr><td>2.</td><td colspan="7">Balagurusamy, E., “Object Oriented Programming with C++”, 3rd Edition, Tata Mc Graw Hill, New Delhi, 2008.</td></tr>
<tr><td>3.</td><td colspan="7">Herbert Schildt, “The Java 2: Complete Reference, 5th Edition, Tata Mc Graw Hill, New York, USA, 2002.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">2012 International Classification of Diseases (ICD)- 9 Vol 1& 2 for diagnostic coding in physician offices and outpatient facilities, Tata Mc Graw Hill, New York, USA, 2012.</td></tr>
<tr><td>2.</td><td colspan="7">Ravichandran, D., “Programming with C++, 2nd Edition Tata Mc Graw Hill, New Delhi, 2007.</td></tr>
</table>

| K.S.Rangasamy College of Technology - Autonomous Regulation | | | | | | | | R 2010 |
|---|---|---|---|---|---|---|---|---|
| Department | Biotechnology | Programme Code & Name | | | BT : B.Tech Biotechnology | | | |
| **Elective IV** | | | | | | | | |
| Course Code | Course Name | Hours / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CA | ES | Total |
| 10 BT E44 | TEXTILE BIOTECHNOLOGY | 3 | 0 | 0 | 3 | 50 | 50 | 100 |
| Objective(s) | To make the students to understand about the new field Biotechnology in textiles. Usage of enzymes, environmental management and textiles in medicine and health care. To create the awareness in textile biotechnology towards their carrier in the field of Textile Biotechnology. | | | | | | | |
| 1 | SCOPE OF BIOTECHNOLOGY IN TEXTILES | | | | Total Hrs | 9 | | |
| Scopes and applications of Biotechnology in textiles, Fiber prepration and Fabric prepration, application of oxidoreductase in Fabric prepration. Wool processing and its appliations. | | | | | | | | |
| 2 | ENZYMES IN TEXTILES | | | | Total Hrs | 9 | | |
| Types of enzymes and their effectiveness against various strains. Proteases, lipases, amylases and celluloses. Laccase, pectinase, peroxidise and Glucose in textile technology. | | | | | | | | |
| 3 | MEDICAL TEXTILES | | | | Total Hrs | 9 | | |
| Healthcare and hygiene products types; advanced textile materials in healthcare; infection control and barrier materials; study of non-woven hygienic products; plasma treated barrier materials Wound – types, healing process; requirement of wound dressing; an overview of wound care materials - study of various kinds of wound care dressing and advanced wound dressings. | | | | | | | | |
| 4 | CHARACTERISATION OF TEXTILE POLYMERS | | | | Total Hrs | 9 | | |
| Polymer solution thermo dynamics; molecular weight and molecular dimensions by end group analysis, osmometry, light scattering, viscometry, gel permeation chromatography, high performance liquid chromatography Infrared, NMR, UV –visible, raman spectroscopy, mass spectroscopy. | | | | | | | | |
| 5 | ENVIRONMENTAL MANAGEMENT FOR TEXTILE INDUSTRY | | | | Total Hrs | 9 | | |
| Biological water treatment methods Identification and reduction of pollution sources in textile wet processing, analysis of textile processing effluents – colour, odour, 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. | | | | | | | | |
| Total hours to be taught | | | | | | 45 | | |
| Text book (s) : | | | | | | | | |
| 1. | Trivedi R.K., “Handbook of Environmental laws, Acts, Guidelines, Compliances and Standards”, Vol. 1, Enviro Media, India, 1996. | | | | | | | |
| 2. | George Thobanoglous and Franklin L. Burton., “Waste Water Engineering and Treatment, Disposal, Reuse (Metcalf & Eddy Inc., California)”, Tata McGraw-Hill Publishing co Ltd, New Delhi, 1995. | | | | | | | |
| Reference(s) : | | | | | | | | |
| 1. | Gupta V.B. and Kothari V.K., “Man Made Fibre Production,” Chapman and Hall, 1985. | | | | | | | |
| 2. | Allison Mathews and Martin Hardingham ., “Medical and Hygiene Textile Production - A hand book”, Intermediate Technology Publications, 1994. | | | | | | | |

| Modules | 10 BT E41 - TISSUE ENGINEERING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Illustrate the basic concepts of tissue engineering such as its origin, triad and acellular prosthesis |
| 2. | Outline the various types of equipments and materials for animal cell culture technology. |
| 3. | Interpret the concept of vascularisation and organization of cells into higher ordered structures |
| 4. | Learn the concept of ecm interaction, composition and delivery with reference to receptors for extracellular matrix molecules. |
| 5. | Characterize the concept of mass transfer and diffusion of simple metabolites |
| 6. | Learn the basics of molecular and cell transport through tissues |
| 7. | Outline the recent advancement such as 3d cultures in tissue engineering and use of scaffolds. |
| 8. | Illustrate the applications of growth factors such as vegf and the process of angiogenesis. |
| 9. | Determine the concept of stem cells and haematopoiesis. |
| 10. | Learn the concepts of cell surface markers and its identification by facs. |

| Modules | 10 BT E42 - CLINICAL TRIAL MANAGEMENT<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Study of various ethical guidelines and principles involved in organ transplantation and Human Genome project |
| 2. | Assess the ethical guidelines for biomedical research on humans |
| 3. | Estimate the biological data in terms of numerical measures using correlation and regression |
| 4. | Apply statistical test for biological data and verifying the significance using ANOVA |
| 5. | Analyze how the trial events are monitored and distributed by Contract Research Organization |
| 6. | Ensure all the regulations and laws pertaining to trial related events |
| 7. | Characterize the types of clinical trial phases and evaluate the protocol approval and informed consent |
| 8. | Demonstrate the responsibilities of sponsor, investigator and ethics committee in trial site |
| 9. | Describe the role of international classification of diseases in medical coding and current procedure terminology |
| 10. | Summarize the process of outsourcing and requirements for starting up a new venture |

| Modules | 10 BT E43 – SYSTEM BIOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Gain the basic aspects of human physiology and anatomy |
| 2. | Access various physiology and anatomy knowledge for clinical trial and medical coding basics |
| 3. | Know medical coding ICD, CPT, HIPAA knowledge to work in BPO's, KPO's. |
| 4. | Solve medical coding, medical billing and outsourcing knowledge for enhance to start own business. |
| 5. | Acquire c language, constant, variables data types and operators and expression to gain working knowledge in KPO's |
| 6. | Access c language basics, programming knowledge will help to create and execute some classical softwares for medical coding and billing. |
| 7. | Know C++, fundamentals, classes & objects; static data and member functions will give extra knowledge of programming. |
| 8. | Acquire destructors; dynamic objects virtual functions will give knowledge to trouble shoot critical problems |
| 9. | Access file management and applications of C language in system biology will enhance to work in out sourcing companies |
| 10. | Know case studies system biology testing softwares boost individuals knowledge to commercialize to software packages for out sourcing companie |

| Modules | 10 BT E44 - TEXTILE BIOTECHNOLOGY<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | Describe the applications and scope of textile biotechnology. |
| 2. | Determine the importance and preparation of different fabric materials for textile industry |
| 3. | Discriminate the type of enzymes and its application of textile industry |
| 4. | Understand the principle and mechanism of different enzyme activity |
| 5. | Analyze the production of different types of healthcare products |
| 6. | Calculate the degree of wound healing and its analysis |
| 7. | Compare the morphological features of different textile polymers |
| 8. | Demonstrate the process of characterization of textile polymers |
| 9. | Apply the various biotechnology methods to clean the effluents |
| 10. | Analyze the toxicity reduction of microbes using biotechnology |

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department:</td><td colspan="2">Biotechnology Value Added Course</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT SE11</td><td colspan="2">MOLECULAR DIAGNOSIS AND REGENERATIVE MEDICINE</td><td>1</td><td>0</td><td>1</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">At the end of the course the students will have a complete knowledge of molecular diagnostics, stem cell research and biomaterial with respect to biomedical applications.</td></tr>
<tr><td>1.</td><td colspan="5">MOLECULAR DIAGNOSTICS</td><td colspan="2">Total Hrs</td><td>4</td></tr>
<tr><td colspan="8">Fundamendals of Molecular diagnostics,diagnosis of bacterial,viral and fungal infection. Identifying human disease genes.</td></tr>
<tr><td>2.</td><td colspan="5">GENETICS IN CHROMOSOMAL DISORDER</td><td colspan="2">Total Hrs</td><td>4</td></tr>
<tr><td colspan="8">Chromosomal diseases: various chromosomal aberrations, Repetition of basic genetic mechanisms in connection with these disorders.Cancer genetics- oncogenes, tumour suppressor genes.</td></tr>
<tr><td>3.</td><td colspan="5">BIOMATERIAL</td><td colspan="2">Total Hrs</td><td>4</td></tr>
<tr><td colspan="8">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</td></tr>
<tr><td>4.</td><td colspan="5">REGENERATIVE MEDICINE</td><td colspan="2">Total Hrs</td><td>4</td></tr>
<tr><td colspan="8">Embryonic Stem Cell Technology, Adult Stem Cell Technology , Advanced Stem Cell Laboratory Techniques and Clinical Applications, Tissue engineering</td></tr>
<tr><td>5.</td><td colspan="5">TECHNIQUES IN MOLECULAR DIAGNOSTICS AND REGENERATIVE MEDICINE</td><td colspan="2">Total Hrs.</td><td>4</td></tr>
<tr><td colspan="8">Reverse transcriptase PCR, Genetic screening of drug response, Synthesis of biomaterial, Isolation and culture of mesenchymal stem cell from Bone marrow.</td></tr>
<tr><td colspan="7">Total Hours Taught</td><td>20</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="7">David E. Bruns, Edward R. Ashwood, Carl A. Burtis. (2007). Fundamentals of Molecular Diagnostics Saunders Group. UK.</td></tr>
<tr><td>2.</td><td colspan="7">Stein M., (2011) Human Stem Cell Technology and Biology: A Research Guide and Laboratory Manual. First Edn. Wiley-Blackwell, New York, USA.</td></tr>
<tr><td colspan="8">Reference(s) :</td></tr>
<tr><td>1.</td><td colspan="7">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-Blackwel, New York, USA.</td></tr>
<tr><td>2.</td><td colspan="7">J.Mao, G. Vunjak-Novakovic et al (Ed): (2008) Translational Approaches in Tissue Engineering & Regenerative Medicine, Artech House, INC Publications. UK.</td></tr>
</table>

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

<table>
<tr><td colspan="8">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td>R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="3">Biotechnology<br>Value Added Course</td><td colspan="2">Programme Code & Name</td><td colspan="2">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="3" rowspan="2">Course Name</td><td colspan="2">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT SE12</td><td colspan="3">CLINICAL RESEARCH MANAGEMENT</td><td>1</td><td>0</td><td>1</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="8">At the end of the course the students will have a complete knowledge of clinical trial phases and design, planning, implementation, data analysis, regulatory and procedural guidelines and ethical considerations.</td></tr>
<tr><td>1.</td><td colspan="5">CLINICAL PHARMACOLOGY AND DRUG DISCOVERY PROCESS</td><td colspan="2">Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>2.</td><td colspan="5">CILNICAL PHASES OF DRUG DEVELOPMENT</td><td colspan="2">Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>3.</td><td colspan="5">DRUG REGULATIONS AND GUIDELINES</td><td colspan="2">Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td>4.</td><td colspan="5">CLINICAL RESEARCH MANAGEMENT</td><td colspan="2">Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="9">Role of CRO and SMO- Audit and Inspection in CR- Protocol designing- CRF designing- SOP designing</td></tr>
<tr><td>5.</td><td colspan="5">ETHICS IN CLINICAL RESEARCH</td><td colspan="2">Total Hrs.</td><td colspan="2">4</td></tr>
<tr><td colspan="9">Background of ethics in CR, a historical overview, codes related to ethics- Highlights of Nuremberg code- Importance of Declaration of Helsinki, Belmont report</td></tr>
<tr><td colspan="7">Total Hours</td><td colspan="2">20</td></tr>
<tr><td colspan="9">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="8">ICMR, (2000) “Ethical guidelines for biological research on human subjects”, Indian council of Medical Research Press, New Delhi,.</td></tr>
<tr><td>2.</td><td colspan="8">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,.</td></tr>
<tr><td>3.</td><td colspan="8">Code of federal regulations and ICH Guidelines GCP Reference guide, 2006.</td></tr>
</table>

The Course is offered by Point Perfect Transcription Services India Private Limited, Coimbatore, Tamil Nadu**.** Students can select the value added course in any semester

<table>
<tr><td colspan="6">K.S.Rangasamy College of Technology - Autonomous Regulation</td><td colspan="3">R 2010</td></tr>
<tr><td colspan="2">Department</td><td colspan="2">Biotechnology<br>Value Added Course</td><td colspan="2">Programme Code & Name</td><td colspan="3">BT : B.Tech Biotechnology</td></tr>
<tr><td colspan="2" rowspan="2">Course Code</td><td colspan="2" rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td colspan="2">10 BT SE13</td><td colspan="2">MEDICAL CODING</td><td>1</td><td>0</td><td>1</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="2">Objective(s)</td><td colspan="7">At the end of the course the students will have a comprehensive knowledge of Human Anatomy & Physiology, Medical Coding, Billing Cycle, RCM, Coding Compliance, and HIPAA Laws</td></tr>
<tr><td>1.</td><td colspan="5">HUMAN ANATOMY & PHYSIOLOGY PART I</td><td>Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="8">Cardio Vascular System, Blood & Its Components ,Integumentary System, Endocrine System, Urology, Male Reproductive System.---- Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies</td></tr>
<tr><td>2.</td><td colspan="5">HUMAN ANATOMY & PHYSIOLOGY PART II</td><td>Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="8">Female Reproductive Systems, Nervous System, Gastro Intestinal System, Pulmonology, Special Sciences, Orthopedics, Lymphatic System---Location, Shape, Size, Structure, Physiology, Pathology, Diagnostic Test, Terminologies</td></tr>
<tr><td>3.</td><td colspan="5">CURRENT PROCEDURE TERMINOLOGY CODING (CPT)</td><td>Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="8">CPT Codes, CPT Description, Medical Record Format,Speciality Listings and its Format, Usage of CPT Manuals, Software usage, Examples of CPT Speciality Code Practice</td></tr>
<tr><td>4.</td><td colspan="5">INTERNATIONAL CLASSIFICATION OF DISEASE CODING(ICD)</td><td>Total Hrs</td><td colspan="2">4</td></tr>
<tr><td colspan="8">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.</td></tr>
<tr><td>5.</td><td colspan="5">MODIIERS, E&M CODING, MEDICAL BILLING CYCLE&OVERVIEW</td><td>Total Hrs.</td><td colspan="2">4</td></tr>
<tr><td colspan="8">Modifiers Listing, Usage and Indexing, E& M codes, classification, Application of E&M, Tabulation, Listings, Software usage, Examples of E&M Code Practice</td></tr>
<tr><td colspan="7">Total Hours</td><td colspan="2">20</td></tr>
<tr><td colspan="8">Text book (s) :</td></tr>
<tr><td>1.</td><td colspan="7">CPT AMA Professional Edition, London, UK, 2013.</td></tr>
<tr><td>2.</td><td colspan="7">ICD 9CM Physicians Vol I and Vol II Contexo A division of Access Intelligence, London, UK, 2013.</td></tr>
<tr><td>3.</td><td colspan="7">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.</td></tr>
</table>

The Course is offered by Professional Infotech Private Limited, Coimbatore, Tamil Nadu**.** Students can select the value added course in any semester

| Modules | 10 BT SE11 - MOLECULAR DIAGNOSIS AND REGENERATIVE MEDICINE<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | describe the applications and scope of molecular diagnosis |
| 2. | determine the importance and applications of personalized medicine |
| 3. | discriminate the type chromosomal disorders |
| 4. | understand the mechanism of origin of cancer |
| 5. | experiment the production of different biomaterials |
| 6. | analyze the nature of different types of biomaterials |
| 7. | compare the morphological features of different type of cell lines |
| 8. | demonstrate the process production of cell cultures |
| 9. | apply the various biotechnology methods for regenerative medicine |
| 10. | analyze the new technologies in the field of regenerative medicine |

| Modules | 10 BT SE12 - CLINICAL RESEARCH MANAGEMENT<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | describe the basic terminologies in clinical research. |
| 2. | determine the importance of drug discovery process and preclinical studies |
| 3. | discriminate the type of micro dosing studies |
| 4. | understand the principle and mechanism of therapeutic confirmatory trial |
| 5. | explain principles of ICH in clinical trial research |
| 6. | enumerate about informed consent role in clinical research |
| 7. | compare and contrast role of CRO and SMO |
| 8. | apply the various methods of protocol designing and CRF designing |
| 9. | demonstrate codes related to ethics of clinical studies |
| 10. | analyze the report of Belmont and Helsinki |

| Modules | 10 BT SE13 - MEDICAL CODING<br>Course Outcomes (Cos) |
|---|---|
| | At the end of the course, the student will be able to |
| 1. | illustrate the basic concepts of human anatomy and physiology |
| 2. | outline the role and applications of human anatomy and physiology in medical coding. |
| 3. | Discuss medical terminologies of human anatomy and physiology |
| 4. | Describe prefix and suffix terms of medical terms used for medical coding |
| 5. | interpret the concept of CPT terminologies |
| 6. | learn the concept of CPT specialty code practice. |
| 7. | characterize the concept of ICD-9,ICD-10 practice for medical coding |
| 8. | learn the basics of software usage in medical coding practices |
| 9. | illustrate the applications of medical billing and medical coding |
| 10. | learn the concepts of E & M code practices |