
# B.Tech. (Full Time) – Biotechnology

# Curriculum & Syllabus

# 2007-08

**Faculty of Engineering & Technology**
**SRM University**
**SRM Nagar, Kattankulathur – 603 203**

**S.R.M UNIVERSITY**
**B.Tech. BIOTECHNOLOGY**
**CURRICULUM AND SYLLABUS**
**2007-08**

**SEMESTER I**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| LE0101 | B | English | 1 | 0 | 2 | 2 |
| MA0111 | B | Mathematics- I | 3 | 2 | 0 | 4 |
| PH0101 | B | Physics | 3 | 0 | 0 | 3 |
| CY0101 | B | Chemistry | 3 | 0 | 0 | 3 |
| GE0101 | E | Basic Engineering-I | 4 | 0 | 0 | 4 |
| **Practical** | | | | | | |
| PD0101 | G | Personality and Development-I* | 0 | 0 | 2 | - |
| GE0107 | G | NSS /NCC/NSO/YOGA | 0 | 0 | 2 | 1 |
| GE0105 | B | Computer Literacy | 0 | 0 | 2 | 1 |
| PH0103 | B | Physics Laboratory | 0 | 0 | 2 | 1 |
| CY0103 | B | Chemistry Laboratory | 0 | 0 | 2 | 1 |
| AR0130 | E | Engineering Drawing | 1 | 0 | 4 | 3 |
| **Total** | | | **15** | **2** | **16** | **23** |
| **Total Contact Hours** | | | **33** | | | |

**Semester – II**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| MA0142 | B | Mathematics-LS -II | 3 | 2 | 0 | 4 |
| PH0102 | B | Material science | 2 | 0 | 2 | 3 |
| GE0104 | B | Principles of Environmental Science | 2 | 0 | 0 | 2 |
| BT0102 | P | Biochemistry | 3 | 0 | 0 | 3 |
| GE0106 | E | Basic Engineering II | 4 | 0 | 0 | 4 |
| BT0104 | P | Cell Biology | 3 | 0 | 0 | 3 |
| GE0108 | G | Value education | 1 | 0 | 0 | 1 |
| **Practical** | | | | | | |
| ME0120 | E | Workshop Practices | 0 | 0 | 4 | 2 |
| CS0140 | B | Computer Practice | 1 | 0 | 2 | 2 |
| BT0108 | P | Biochemistry Laboratory | 0 | 0 | 3 | 1 |
| PD0102 | G | Personality Development-II* | 0 | 0 | 2 | - |
| **Total** | | | **19** | **2** | **13** | **25** |
| **Total Contact Hours** | | | **34** | | | |

G: General programme comprising language/communication skills, humanities and social sciences, economics and principles of management, and NSS/NCC/NSO/YOGA.
B: Basic sciences comprising Computer Literacy with Numerical Analysis, Mathematics, Physics, and Chemistry.
E: Engineering Sciences and Technical Arts comprising Engineering Graphics, Workshop Practice, Basic Engineering, etc.
P: Professional subjects corresponding to the Branch of Studies, which will include core subjects, electives, and project work.

* Audit course

**Semester – III**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0201 | P | Enzyme technology | 3 | 0 | 0 | 3 |
| BT0203 | P | Genetics and Cytogenetics | 3 | 0 | 0 | 3 |
| BT0205 | P | Immunology | 3 | 0 | 0 | 3 |
| BT0207 | P | Microbiology | 3 | 0 | 0 | 3 |
| CH0205 | E | Chemical process calculations | 3 | 0 | 0 | 3 |
| CH0215 | E | Mechanical operations & heat transfer | 3 | 0 | 0 | 3 |
| LE0201/0203 / LE0205 | G | German Language /Japanese Language / French Language Phase - I | 2 | 0 | 0 | 2 |
| BT0217 | B | Computer Skills | 1 | 0 | 2 | 2 |
| **Practical** | | | | | | |
| BT0211 | P | Microbiology Laboratory | 0 | 0 | 2 | 1 |
| BT0213 | P | Cell Biology laboratory | 0 | 0 | 2 | 1 |
| BT0215 | P | Immunology Laboratory | 0 | 0 | 2 | 1 |
| PD0201 | G | Personality Development-III | 0 | 0 | 2 | 1 |
| **Total** | | | **21** | **0** | **10** | **26** |
| **Total Contact Hours** | | | **31** | | | |

**Semester IV**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0202 | P | Molecular Biology | 3 | 0 | 0 | 3 |
| BT0204 | P | Bioprocess Principles | 3 | 0 | 0 | 3 |
| BT0206 | P | Biophysics | 3 | 0 | 0 | 3 |
| CH0206 | E | Momentum Transfer | 3 | 0 | 0 | 3 |
| CH0216 | E | Chemical Engineering Thermodynamics | 3 | 0 | 0 | 3 |
| MA0244 | B | Biostatistics | 3 | 1 | 0 | 4 |
| LE0202/LE0204 /LE206 | G | German Language /Japanese Language / French Language Phase - II | 2 | 0 | 0 | 2 |
| **Practical** | | | | | | |
| BT0208 | P | Comprehension-I | 0 | 2 | 0 | 1 |
| BT0210 | P | Molecular Biology Laboratory | 0 | 0 | 2 | 1 |
| BT0212 | P | Genetics laboratory | 0 | 0 | 2 | 1 |
| PD0202 | G | Personality Development-IV | 0 | 0 | 2 | 1 |
| **Total** | | | **20** | **3** | **6** | **25** |
| **Total Contact Hours** | | | **29** | | | |

**Semester – V**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0301 | P | Vector Biology and Gene manipulation | 3 | 0 | 0 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| BT0303 | P | Animal Biotechnology | 3 | 0 | 0 | 3 |
| BT0305 | P | Analytical Techniques | 2 | 0 | 0 | 2 |
| BT0307 | P | Plant Biotechnology | 3 | 0 | 0 | 3 |
| E-1 | P | Elective-1 | 3 | 0 | 0 | 3 |
| CH0319 | E | Mass Transfer | 3 | 0 | 0 | 3 |
| **Practical** | | | | | | |
| BT0309 | P | Bio process Engineering Laboratory | 0 | 0 | 3 | 1 |
| BT0311 | P | Gene Manipulation laboratory | 0 | 0 | 3 | 1 |
| BT0317 | P | Industrial Training* | 0 | 0 | 2 | 1 |
| CH0331 | P | Mass Transfer laboratory | 0 | 0 | 4 | 2 |
| PD0301 | G | Personality Development V | 1 | 0 | 2 | 2 |
| **Total** | | | **18** | **0** | **14** | **24** |
| **Total Contact Hours** | | | **32** | | | |

* An industrial training of minimum two weeks has to be undergone by the student in the winter/summer vacation of the IV semester.

**Semester – VI**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0302 | P | Genomics and Proteomics | 3 | 0 | 0 | 3 |
| BT0304 | P | Protein Engineering | 3 | 0 | 0 | 3 |
| BT0306 | P | Bioprocess Engineering | 3 | 0 | 0 | 3 |
| BT0308 | P | Bioinformatics | 2 | 0 | 1 | 3 |
| CH0318 | E | Instrumentation and Process control | 3 | 0 | 0 | 3 |
| E-2 | P | Elective-2 | 3 | 0 | 0 | 3 |
| **Practical** | | | | | | |
| BT0310 | P | Plant cell and Tissue culture Laboratory | 0 | 0 | 3 | 1 |
| BT0312 | P | Animal Cell culture Laboratory | 0 | 0 | 3 | 1 |
| BT0314 | P | Fermentation laboratory | 0 | 0 | 3 | 1 |
| BT0316 | P | Comprehension-II | 0 | 2 | 0 | 1 |
| PD0302 | G | Personality Development VI | 1 | 0 | 2 | 2 |
| **Total** | | | **18** | **2** | **12** | **24** |
| **Total Contact Hours** | | | **32** | | | |

**Semester – VII**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0403 | P | Bioreactor design | 3 | 0 | 0 | 3 |
| BT0407 | P | Bioseparation Technology | 3 | 0 | 0 | 3 |
| BT0411 | P | Fermentation technology | 3 | 0 | 0 | 3 |
| E-3 | P | Elective-3 | 3 | 0 | 0 | 3 |
| **Practical** | | | | | | |
| | P | Elective lab | 0 | 0 | 3 | 1 |
| BT0413 | P | Bioseparation Lab | 0 | 0 | 3 | 1 |
| BT0417 | P | Industrial Training** | 0 | 0 | 2 | 1 |
| CH0409 | E | Bioprocess equipment Designing and Drawing lab | 0 | 0 | 4 | 2 |
| **Total** | | | **12** | **0** | **12** | **17** |
| **Total Contact Hours** | | | **24** | | | |

**An industrial training of minimum two weeks has to be undergone by the student in the winter/summer vacation of the VI semester.

**Semester – VIII**

| Code | Category | Course | L | T | P | C |
|---|---|---|---|---|---|---|
| **Theory** | | | | | | |
| BT0402 | P | Biosafety, Bioethics, IPR & Patents | 2 | 0 | 0 | 2 |
| BT0404 | P | Bionanotechnology | 3 | 0 | 0 | 3 |
| **Practical** | | | | | | |
| BT0406 | P | Project Work | 0 | 0 | 16 | 8 |

| Total | 5 | 0 | 16 | 13 |
|---|---|---|---|---|
| Total Contact Hours | 21 | | | |

**Summary Table**

| Semester | I | II | III | IV | V | VI | VII | VIII | Total | % |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 23 | 25 | 26 | 25 | 24 | 24 | 17 | 13 | 177 | 100 |
| G | 1 | 1 | 3 | 3 | 2 | 2 | 0 | 0 | 12 | 6.78 |
| B | 15 | 11 | 2 | 4 | 0 | 0 | 0 | 0 | 32 | 18.08 |
| E | 7 | 6 | 6 | 6 | 3 | 3 | 2 | 0 | 33 | 18.64 |
| P | 0 | 7 | 15 | 12 | 19 | 19 | 15 | 13 | 100 | 56.49 |

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 177**

**LIST OF ELECTIVES**

A student is required to choose a module during the 5th semester (Elective 1) and will be allowed to choose from the same module for Electives 2 and 3. The student will not be permitted to move from one module to another during 6th and 7th semesters.

| Code | Course | L | T | P | C |
|---|---|---|---|---|---|
| | **I. Medical Biotechnology** | | | | |
| BT0325 | Cancer Biology | 3 | 0 | 0 | 3 |
| BT0376 | Drug and Pharmaceutical Biotechnology | 3 | 0 | 0 | 3 |
| BT0378 | Molecular Modeling and Drug design | 3 | 0 | 0 | 3 |
| BT0415 | Stem Cells in Health Care | 3 | 0 | 0 | 3 |
| BT0417 | Medical Biotechnology Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **II . Plant Biotechnology** | | | | |
| BT0327 | Phytochemical Techniques | 3 | 0 | 0 | 3 |
| BT0380 | Inducible Gene Expression in Plants | 3 | 0 | 0 | 3 |
| BT0382 | Pathogenesis Related Proteins in Plants | 3 | 0 | 0 | 3 |
| BT0419 | Plant Hormones and Signal Transduction | 3 | 0 | 0 | 3 |
| BT0421 | Plant Biotechnology Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **III. Food Biotechnology** | | | | |
| FP0325 | Food fermentation technology | 3 | 0 | 0 | 3 |
| FP0364 | Food microbiology and contamination | 3 | 0 | 0 | 3 |
| FP0459 | Therapeutic nutrition | 3 | 0 | 0 | 3 |
| FP0461 | Food microbiology and Fermentation laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **IV. Environmental Engineering** | | | | |
| BT0329 | Environmental Biotechnology | 3 | 0 | 0 | 3 |
| BT0384 | Environmental Microbiology and Biodiversity | 3 | 0 | 0 | 3 |
| BT0386 | Energy Engineering and Technology | 3 | 0 | 0 | 3 |
| BT0423 | Environmental Bioremediation Technologies | 3 | 0 | 0 | 3 |
| BT 0425 | Environmental Engineering Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **V. Enzyme Technology** | | | | |
| BT0331 | Enzyme Science and Engineering | 3 | 0 | 0 | 3 |
| BT0388 | Metabolic Engineering | 3 | 0 | 0 | 3 |
| BT0427 | Recombinant Enzyme and Therapeutic Agents Production | 3 | 0 | 0 | 3 |
| BT0429 | Enzyme technology Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **VI. Biophysical Engineering** | | | | |
| BT0333 | Computation of Biological Molecules | 3 | 0 | 0 | 3 |
| BT0390 | Biophysical Methods | 3 | 0 | 0 | 3 |
| BT0431 | Macromolecular Interaction | 3 | 0 | 0 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| BT0433 | Biophysical Engineering Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **VII. Fermentation Technology** | | | | |
| BT0335 | Fermentation Technology and applications | 3 | 0 | 0 | 3 |
| BT0392 | Distillates and Fermentation technology | 3 | 0 | 0 | 3 |
| BT0435 | Brewing Science and Practice | 3 | 0 | 0 | 3 |
| BT0437 | Fermentation Technology Laboratory | 0 | 0 | 3 | 1 |
| | | | | | |
| | **VIII. Bioinformatics** | | | | |
| BT0337 | Bioinformatics algorithms | 3 | 0 | 0 | 3 |
| BT0394 | Molecular Simulation of Biomolecules | 2 | 0 | 1 | 3 |
| BT0439 | PERL Programming & BioPerl | 3 | 0 | 0 | 3 |
| BT0441 | Perl Programming Laboratory | 0 | 0 | 3 | 1 |

## ELECTIVES OFFERED TO THE OTHER BRANCHES OF THE UNIVERSITY

| Code | Course | L | T | P | C |
|---|---|---|---|---|---|
| | | | | | |
| BT0445 | System Biology | 3 | 0 | 0 | 3 |
| BT0446 | Biocatalysis | 3 | 0 | 0 | 3 |
| BT0447 | Physics of Protein-DNA Interaction | 3 | 0 | 0 | 3 |
| BT0448 | Bioterrorism | 3 | 0 | 0 | 3 |
| BT0449 | Biotechnology Explorations-Applying the Fundamentals | 3 | 0 | 0 | 3 |
| BT0450 | Bioprospecting | 3 | 0 | 0 | 3 |
| BT0451 | Molecular Farming | 3 | 0 | 0 | 3 |
| BT0452 | Biomining | 3 | 0 | 0 | 3 |

## SEMESTER I

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0101** | **ENGLISH** | **1** | **0** | **2** | **2** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

To provide an adequate mastery of technical communicative English Languages training primarily, reading writing skills, secondarily listening and speaking skills.

**INSTRUCTIONAL OBJECTIVES**

To provide language training to the engineering students which will enable them to understand and acquire knowledge in technical subjects.

**LISTENING**

Listening Practice – Hints on Listening – Practice Questions

Note Taking**:** Note Taking Strategies

**SPEAKING**

Definitions: Expressing Opinions (agreement / disagreement )-Offering Suggestion – Technical Definition – Defining – Describing Objects –speaking practice

Phonetics**:** Pronunciation – Phonetic transcription-Stress-Intonation

**READING**

Comprehension: Skimming-scanning-close reading-Comprehension – Transferring Information – Exercise – An unseen passage should be given and questions may be asked in the form of True or False statements, MCQ, short answers.

Transcoding: Interpreting tables, flow charts, piechart, bar diagram, tree diagram, graphs

**WRITING**
Art of Writing: Writing Language – Rules for effective writing – Technical Essay Writing – Exercise

Report Writing**:** Technical Report Writing – Lab Report – Exercise

Letter Writing: Formal Letters – Letter to the Editor – Letter Inviting Dignitaries – Letter of Application – Placing an Order – Placing Curriculum Vitae – Placing an order

Dialogue Writing

**FOCUS ON AND COMMUNICATION AND "COMPUNICATION"**
Communication: Basic Concepts – Process – Kinds – Routes – Forms – Factors – Barriers – Triangles Communication (Communicate through Computers – Power Point & Tele Conference).

**INTERNAL ASSESSMENT**
Based on the submission and test performance of the students marks may be awarded.

**TEXT BOOKS**
1. Abraham Benjamin Samuel '*Practical Communication (Communicative English ) LSRW2000'* – SRMEC – June 2002 Edition.
2. Staff of the Department of Humanities and Social Science, Anna University, "*English for Engineers / BEC and Technologist Vol.-I"*. Orient Longman, 1990.

**REFERENCE BOOKS**
1. Herbert. A. J. *The structure of Technical English,* Orient Longman 1995.
2. Pickett and Laster, '*Technical English, Writing, Reading and Speaking'*, New York Harper and Row Publications, 1997.
3. *Interactive course in phonetics and spoken English* published by Acoustics Engineers (ACEN) 2002.
4. Munter, Mary, "*Business Communication Strategy and Skill*", Prentice Hall Inc., New Jersey, 1987.

| | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **MA0111** | **MATHEMATICS – I** | **3** | **2** | **0** | **4** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE:**
To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

**INSTRUCTIONAL OBJECTIVES**
At the end of the course, the students should have been exposed fully with the knowledge of Matrices and its applications the trigonometry, the concepts of Differential Calculus and Integral Calculus and their simple applications.

**MATRICES**
*Review of types of matrices, properties. Inverse matrix, Cramer's rule for solving a system of linear equations – Rank of Matrix – Consistency and Inconsistency of a system of m linear equations in 'n' unknowns –Cayley Hamilton theorem – Eigen values and eigen vectors of a real matrix.

**TRIGONOMETRY**
*****Review of complex numbers -- De Moiver's theorem and its applications -- Expansion of $\sin n\theta \cos n\theta$ in terms of $\sin\theta$ *and* $\cos\theta$ -- Expansion of $\tan n\theta$ in terms of $\tan\theta$ -- Expansion of $\sin^n\theta$ *and* $\cos^n\theta$ in terms of sines and cosines of multiples of $\theta$ -- Hyperbolic functions and inverse hyperbolic functions

**DIFFERENTIAL CALCULUS**
Differentiation and Derivatives of simple functions – Successive Differentiation – Various forms of Algebraic and Trigonometric functions – Problems

**INTEGRAL CALCULUS**
Various types of integration –by – Reduction formula for $e^{ax}x^n$, $\sin^n$, $\cos^n x$, $\sin^n x\cos^m x$ (without proof)-Problems

**APPLICATIONS OF DIFFERENTIAL CALCULUS & INTEGRAL CALCULUS**

Applications of differential calculus & integral calculus -- Tangent & Normal-Radius of curvature – Velocity and acceleration -- Integral calculus - Length & Area

***No questions should be asked in the Review part**

**TEXT BOOK**
1. Grewal B.S, *Higher Engg Maths*, Khanna Publications, 38th Edition.
2. Veerajan, T., *Engineering Mathematics*, Tata McGraw Hill Publishing Co., New Delhi,2000
3. Dr.V.Ramamurthy & Dr. Sundarammal Kesavan *Engineering Mathematics – Vol I & II* Anuradha Publications, Revised Edition 2006.

**REFERENCE BOOKS:**
1. Kreyszig.E, *Advanced Engineering Mathematics*, 8th edition, John Wiley & Sons. Singapore,2001.
2. Kandasamy P et. al., *Engineering Mathematics*, Vol.I (4th revised edition), S.Chand &Co., New Delhi,2000.
3. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., *Advanced Mathematics for Engineering students, Volume I (2nd edition)*, S.Viswanathan Printers and Publishers, 1992.
4. Venkataraman M.K., *Engineering Mathematics – First Year (2nd edition)*, National Publishing Co., Chennai, 2000.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PH0101** | **PHYSICS** | **3** | **0** | **0** | **3** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**
The purpose of this course is to develop scientific temper and analytical capability through learning physical concepts and their applications in engineering and technology. Comprehension of some basic physical concepts will enable the students to logically solve engineering problems.

**INSTRUCTIONAL OBJECTIVES**
At the end of the course, the student will be able to:
1. To understand the general scientific concepts required for technology,
2. Apply the concepts in solving engineering problems,
3. Explain scientifically the new developments in engineering and technology, and
4. Get familiarized with the concepts, theories, and models behind many technological applications.

**PROPERTIES OF MATTER AND SOUND**
**Properties of Matter:** Hooke's law – Twisting couple on a cylinder – Shafts – Torsion pendulum – Bending of beams – Bending moment – Uniform bending and non-uniform bending – I shape girder. **Sound:** Shock waves – Mach number (simple problems) – Ultrasonic production (magnetostriction and piezoelectric methods) and application – Acoustics of buildings – Sources and impacts of noise – Sound level meter – Control of noise pollution.

**ELECTROMAGNETISM AND MICROWAVES**
**Electromagnetism:** Divergence, curl and gradient – Maxwell's equations – Wave equation for electromagnetic waves – Propagation in free space – Pointing vector – Rectangular and circular wave guides. **Microwaves:**

Properties and applications – Generation by magnetron and reflex klystron oscillator – Travelling wave tube – Biological effects.

**OPTICS**

**Photometry:** Principles and Lummer-Brodhun photometer. **Lasers:** Principles and characteristics – Types of lasers ($CO_2$, excimer, NdYAG, GaAs, free electron) – Holographic mass storage. **Optical Fiber:** Principles – Physical structure and types – Optical fiber communication. **Photo elasticity:** Theory and applications.

**CRYSTAL PHYSICS AND CRYOGENICS**

**Crystal Physics:** Crystal directions – Planes and Miller indices – Basic symmetry elements – Translational symmetry elements – Reciprocal lattice – Diamond and HCP crystal structure – Imperfections in crystals. **Cryogenics:** Methods of liquefaction of gases (cascade process, Linde's process, and adiabatic demagnetization process) – Measurement of cryogenic temperatures.

**ENERGY PHYSICS**

Introduction to non-conventional energy sources – Solar cells – Thermoelectric power generators – Thermionic power generator – Magneto hydrodynamic power generator – Fuel cells ($H_2O_2$) – Solid state batteries (Lithium) – Low voltage and high voltage nuclear cells – Thermocouple based nuclear cell – Ultra capacitors.

**TEXT BOOKS**


1. Arumugam, M., *Engineering Physics, 2nd edition*, Anuradha Publishers, Kumbakonam, 2003.
2. Gaur and Gupta, *Engineering Physics, 7th edition*, Dhandapani and Sons, New Delhi, 1997.
3. Thiruvadigal, J. D., Ponnusamy, S., Vasuhi, P. S. and Kumar, C., *Physics for Technologists*, 5th edition, Vibrant Publication, Chennai, 2007.


**REFERENCE BOOKS**


1. Vasudeva, A. S., *Modern Engineering Physics,* Revised edition, S. Chand and Company Ltd., New Delhi, 2004.
2. Vasudevan, D. N., *Fundamentals of Magnetism and Electricity, 11th edition*, S. Chand and Company Ltd., New Delhi, 1983.
3. Nair, K. P. R., *Atoms, Molecules and Lasers*, Narosa Publishing House, New Delhi, 2006.
4. Pillai, S. O., *Solid State Physics,5th edition*, New Age International (P) Ltd., New Delhi, 2004.
5. Khan, B. H., *Non-Conventional Energy Resources, Mechanical Engineering Series*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **CY0101** | **CHEMISTRY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | Nil | | | | |

**PURPOSE**

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

**INSTRUCTIONAL OBJECTIVES**

The students should be conversant with

1. The role of applied chemistry in the field of engineering.
2. The knowledge of water quality parameters and the treatment of water.
3. The principles involved in corrosion and its inhibitions.
4. Important analytical techniques, instrumentation and the applications.
5. Knowledge with respect to the phase equlibria of different systems.

**TECHNOLOGY OF WATER**

Water quality parameters: Physical, Chemical & Biological - Hardness of water – estimation of hardness (EDTA method & O. Hehner's method), Alkalinity – determination – disadvantages of using hard water in boilers: Scale, sludge formation – disadvantages – prevention – treatment: Internal conditioning – phosphate, calgon and carbonate conditioning methods – External: Zeolite, ion exchange methods - desalination – reverse osmosis and electrodialysis - domestic water treatment.

**CORROSION AND ITS CONTROL**

Corrosion: Basic concepts – principles, mechanism of chemical, electrochemical corrosion – Pilling Bedworth rule – galvanic corrosion – differential aeration corrosion - pitting corrosion - stress corrosion - factors influencing corrosion.

Corrosion control: cathodic protection – sacrificial anodic method – corrosion inhibitor. Protective coatings: surface preparation for metallic coatings - electro plating and electroless plating - chemical conversion coatings – anodizing, phosphating & chromate coating.

**PHASE EQUILIBRIA**

Phase rule: Statement – explanation of the terms involved - one component system (water system only). Condensed phase rule - thermal analysis – two component systems: simple eutectic, Pb-Ag; Br, Cd - solid solution Cu-Ni and compound formation Mg-Zn - applications of eutectics.

**POLYMERS AND REINFORCED PLASTICS**

Classification of polymers – types of polymerization reactions – mechanism of addition polymerization: free radical, ionic and ziegler – Natta - effect of structure on the properties of polymers – strength, plastic deformation, plastics elasticity and physical nature –Preparation and properties of important resins:- Polyethylene, PVC, PMMA, Polyester, Teflon Bakelite, Epoxy resins, compounding of plastics, moulding methods - injection, extrusion, compression and calendaring - reinforced plastics – FRP – Carbon, Graphite, Glass– applications.

**INSTRUMENTAL METHODS OF ANALYSIS**

Basic principles, instrumentation of potentiometry, flame photometry – applications. Elementary theory – principle – instrumentation of UV – visible spectroscopy and atomic absorption spectroscopy and infrared spectroscopy

**TEXT BOOKS**


1. Jain.P.C and Monika Jain, "*Engineering Chemistry*", Danpat Raj publishing company (P) Ltd, New Delhi – 2002.
2. Dara.S.S, *Text book of Engineering Chemistry*, S. Chand & Company Ltd, New Delhi 2003.
3. Willard H.A., Merit L.L and Dean J.A., "*Instrumental methods of analysis*" *6th Edition* Van Nostrand, 1986.


**REFERENCE BOOKS**


1. Kuriacose J.C. and Rajaram J. *Chemistry in Engineering and Technology, Volume II,* Tata McGraw Hill p.b. Co., 1988.
2. Jeyalakshmi.R & Ramar. P, *Engineering Chemistry*, 1st Edition, Devi Publications, Chennai 2006.
3. Kamaraj.P & Arthanareeswari. M, *Applied Chemistry, 2nd Edition*, Sudhandhira Publications, 2003.
4. Arivalagan. K, *Engineering Chemistry, 1st Edition*, Mass publications, 2007.
5. P.Kamatchi, *Applied Chemistry-I*, Ponnuswamy publications, Chennai.
6. Dr. Helen P Kavitha, *Engineering Chemistry – I, ILA* Publications, 2002


| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0101** | **BASIC ENGINEERING – I** | **4** | **0** | **0** | **4** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PART A CIVIL ENGINEERING**

**PURPOSE**

To get exposed to the glimpses of Civil Engineering topics that is essential for an Engineer.

**INSTRUCTIONAL OBJECTIVES**

1. To know about different materials and their properties.
2. Engineering aspects related to buildings.
3. To know about importance of Surveying.
4. To know about the transportation systems.
5. To get exposed to the rudiments of engineering related to Dams, Water Supply, Transportation system and Sewage Disposal.

**BUILDING MATERIALS AND THEIR PROPERTIES**

Introduction - Civil Engineering – Building Materials – Brick, Stone, Cement, Steel, Concrete, Timber – Properties – Uses. Units – Stress, strain and three modulii of elasticity – factor of safety - Centre of Gravity and Moment of Inertia for rectangle and circular section – simple problems.

**BUILDINGS AND THEIR COMPONENTS**

Buildings – Classification - Components of buildings and their functions, Foundations - functions – classification of foundations – Bearing capacity Floorings – functions - Types - Cement Concrete flooring – Mosaic flooring - Marble flooring, Roofs - Types – Requirements – Madras Terrace roof. Tall structure – types of structural systems.

**UTILITY AND SERVICES**

Surveying - Objective – Principles – Classification – Instruments used for Surveying. Dams - Purpose – Selection of site – Classification – Gravity dam (cross-section details only) Transportation system - Classification – Roadway - components – classification of roads - Railway – Cross-section of permanent way-components parts and functions. Docks and Harbour – classification – Terminology Bridges –components of a bridge - types of bridges.Water supply - Sources - Standards of drinking water (BIS) – elementary treatment methods – RO System Sewage disposal – Septic tank – function and components.

**TEXT BOOKS**


1. Raju K.V.B., Ravichandran P.T., *Basics of Civil Engineering*, Ayyappa Publications, Chennai, 2000.
2. Ramesh Babu, *Civil Engineering* , VRB Publishers, Chennai, 2000.


**REFERENCE BOOKS**


1. Rangwala,S.C., *Engineering Materials*, Charotar Publishing House, Anand, 1980.
2. *National Building Code of India*, Part V, Building Materials, 2005
3. Surendra Singh, *Building Materials*, Vikas Publishing Company, New Delhi, 1996


**PART B MECHANICAL ENGINEERING**

**PURPOSE**

To familiarize the students with the basics of Mechanical Engineering.

**INSTRUCTIONAL OBJECTIVES**

To familiarize with

1. The basic machine elements
2. The Sources of Energy and Power Generation
3. The various manufacturing processes

**MACHINE ELEMENTS**

**Springs:** Helical and leaf springs – Springs in series and parallel. **Cams:** Types of cams and followers – Cam profile. **Power Transmission:** Gears (terminology, spur, helical and bevel gears, gear trains). Belt drives (types). Chain drives. **Simple Problems.**

**ENERGY**

**Sources:** Renewable and non-renewable (various types, characteristics, advantages/disadvantages). **Power Generation:** External and internal combustion engines - Hydro and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). **Simple Problems.**

**MANUFACTURING PROCESSES**

**Sheet Metal Work:** Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). **Welding:** Types – Equipments – Tools and accessories – Techniques employed (applications, advantages / disadvantages (gas and arc welding only)) – Gas cutting – Brazing and soldering. **Lathe Practice:** Types - Description of main components – Cutting tools – Work holding devices – Basic operations. **Simple Problems Drilling Practice:** Introduction – Types – Description – Tools S**imple Problems**

**TEXT BOOKS**


1. Kumar, T., Leenus Jesu Martin., and Murali, G., *Basic Mechanical Engineering*, Suma Publications, Chennai, 2007.

2. Prabhu, T. J., Jai Ganesh, V., Jebaraj, S., *Basic Mechanical Engineering*, Scitech Publications, Chennai, 2000.

**REFERENCE BOOKS**

1. Hajra Choudhary, S.K. and Hajra Choudhary, A. K., *Elements of Manufacturing Technology Vols. I & II*, Media Publishers, 1986.
2. Nag, P.K., *Power Plant Engineering*, Tata McGraw-Hill, New Delhi, 2006.
3. Palanichamy, M.S., *Basic Civil & Mechanical Engineering*, Tata McGraw-Hill , New Delhi 1991.
4. Nagpal G. R., *Power Plant Engineering*, Khanna Publisher, Delhi,2004

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD0101** | **PERSONALITY DEVELOPMENT - I** | **0** | **0** | **2** | **0** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**

1. To guide thought process.
2. To groom students' attitude.
3. To develop communication skill.
4. To build confidence.

**METHODOLOGY**

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation
5. Empirical Learning

Self-analysis SWOT - Time management - Creative chain story telling

Vocabulary games I – Attitude - Interpersonal skills

Motivation I - Vocabulary games II - Article review

Team building exercise - Critical Thinking - Event Management

Business situation - Leadership Qualities - Review

**SCHEME OF INSTRUCTION**

Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**

Complete internal evaluation on a regular Basis

| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0107** | NSS/NCC/NSO/YOGA | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**I. YOGA SYLLABUS**

| PRACTICE | | LECTURE |
|---|---|---|
| I | Meditation – Agnai, Asanas, Kiriyas, Bandas, Muthras | Benefits of Agnai Meditation |
| II | Meditation Santhi Physical Exercises (I & II) | Benefits of santhi Meditation |
| III | Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras | Lecture & Practice |
| IV | Meditation Santhi Physical Exercises III & IV | Analysis of Thought |
| V | Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras | Benefits of Thuriyam |
| VI | Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras | Attitude |
| VII | Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras | Importance of Arutkappy & Blessings |
| VIII | Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras | Benefits of Blessings |
| | | **Hours = 30** |

**TEXT BOOKS:**

1. Vedatri Maharshi , *"Yoga for Modern Age"*
2. Vedatri Maharshi, " *Simplified Physical Exercises"*

**II. NATIONAL SPORTS ORGANISATION (NSO)**

Each student must select two of the following games and practice for two hours per week. An attendance of 80% is compulsory to earn the credits specified in the curriculum.

**List of games:**

1. Basket Ball
2. Football
3. Volley Ball
4. Ball Badminton
5. Cricket
6. Throwball

**III. NATIONAL CADET CORPS (NCC)**

Any student enrolling as a member of National Cadet Core (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of academic year.

Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum.

**IV. NATIONAL SERVICE SCHEME (NSS)**

A student enrolling as member of NSS will have to complete 60 hours of training / social service to be eligible to earn the credits specified in the curriculum.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0105** | **COMPUTER LITERACY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This Lab Course will enable the students to understand the basics of computer and to know the basics of MS-Office.

**INSTRUCTIONAL OBJECTIVES**

- To learn the basics of computer.
- To work on MS-Word, Ms-Excel, Ms-Power Point and Ms-Access

**EXPERIMENTS TO IMPLEMENT**

1. Study experiment on evolution of computer programming languages.
2. Suggest some of the Network Topologies that can be incorporated in your campus. Justify your choice.
3. Experiments to demonstrate directory creation and file creation.
4. Create a document with all formatting effects.
5. Create a document with tables.
6. Create labels in MS word.
7. Create a document to send mails using mail merge option.
8. Create an Excel File to analyze the student's performance. Create a chart for the above data to depict it diagrammatically.
9. Create Excel sheet to use built-in-function.
10. Create Excel sheet to maintain employee information and use this data to send mails using mail merge.
11. Create a Power Point presentation for your personal profile with varying animation effects with timer.
12. Consider student information system which stores student personal data, mark information and non academic details.
    * Use MS Access to create Tables and execute SQL queries to do this following
    * Display all student records.
    * Display student details with respect to his identity.
    * Delete some records from the table.
    * Find total marks obtained by student in each list.

**TEXT BOOK**

1. *Introduction to Information Technology*" ITL Education Solutions Ltd., Pearson 2nd Edition, 2006.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PH0103** | **PHYSICS LABORATORY** | **0** | **0** | **2** | **1** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

The purpose of this course is to develop scientific temper and analytical capability among the engineering students.

**INSTRUCTIONAL OBJECTIVES**

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

1. Understand scientific concepts in measurement of different physical variables
2. Develop the skill in arranging and handling different measuring instruments and
3. Get familiarized with the errors in various measurements and planning / suggesting how these contributions may be made of the same order so as to make the error in the final result small.

**LIST OF EXPERIMENTS**

1. Determination of Young's Modulus of the material – Uniform bending
2. Determination of Rigidity Modulus of the material – Torsion Pendulum
3. Determination of velocity of Ultrasonic waves in liquids
4. Determination of dispersive power of a prism using spectrometer
5. Determination of laser parameter – Divergence and wavelength for a given laser source – laser grating
6. Particle size determination using laser
7. Study of attenuation and propagation characteristics of optical fiber cable
8. Calibration of voltmeter using potentiometer.
9. Calibration of ammeter using potentiometer.
10. Construction and study of regulation properties of a given power supply using IC

**REFERENCE BOOKS**

1. Chattopadhyay, D., Rakshit, P. C. and Saha, B., *An Advanced Course in Practical Physics, 2nd edition*, Books & Allied Ltd., Calcutta, 1990.

2. Chauhan and Singh, *Advanced Practical Physics, Revised edition*, Pragati Prakashan, Meerut, 1985.
3. Thiruvadigal. J. D., Ponnusamy. S., Vasuhi. P. S. and Kumar. C, *Hand Book of Practical Physics, 5th edition,* Vibrant Publication, Chennai, 2007.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **CY0103** | **CHEMISTRY LABORATORY** | **0** | **0** | **2** | **1** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

An integrated laboratory course consists of experiments from applied chemistry and is designed to illustrate the underlying principles of measurement techniques, synthesis, dynamics and chemical transformation.

**INSTRUCTIONAL OBJECTIVES**

Students should be able to understand the basic concept and its applications.

**LIST OF EXPERIMENTS**

1. Preparation of standard solutions.
2. Estimation of total hardness, permanent and temporary hardness by EDTA method.
3. Conductometric titration – determination of strength of an acid.
4. Estimation of iron by potentiometer – titration.
5. Determination of molecular weight of polymer by viscosity average – method.
6. Determination of dissolved oxygen in a water sample by Winkler"s method
7. Determination of Na / K in water sample by Flame photometry.
8. Estimation of Copper in ore.
9. Estimation of nickel in steel.
10. Determination of total alkalinity and acidity of a water sample.

**REFERENCE**

1. *Chemistry department manual, Edition, 2003.*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **AR0130** | **ENGINEERING DRAWING** | **1** | **0** | **4** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

1. To draw and interpret various projections of 1D, 2D and 3D objects.

**INSTRUCTIONAL OBJECTIVES**

To familiarize with

1. The construction of geometrical figures
2. The projection of 1D, 2D & 3D elements

**FUNDAMENTALS OF ENGINEERING GRAPHICS**

Lettering, two dimensional geometrical constructions, conics, representation of three -dimensional objects – principles of projections – standard codes – projection of points.

**PROJECTION OF LINES**

Projection of straight lines

**PROJECTION OF SOLIDS**

Sections of solids and development of surfaces

**PICTORIAL PROJECTIONS-I**

Orthographic projection, isometric projection of regular solids & combination of solids

**PICTORIAL PROJECTIONS-II**

Conversion of orthographic to isometric -- Introduction to perspective projection

**TEXT BOOKS**

1. Ramachandran,S. "*Engineering Drawing*", Private Publication, Chennai, 2002.
2. Natarajan.C. R.. "*Engineering Drawing & Graphics*", Private Publication, Chennai, 1990.
3. Narayanan K.L & Kannaiah P., "*Engineering Graphics*", Scitech Publications, Chennai, 1999.

**REFERENCE BOOKS**

1. Bhatt N.D., "*Elementary Engineering Drawing (First Angle Projection)*",Charotar Publishing Co., Anand, 1999.
2. Venugopal.K. "*Engineering Drawing & Graphics*", New Age international Pvt. Ltd., 1999.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **MA0142** | **MATHEMATICS – LS-II** | **3** | **2** | **0** | **4** |
| | Prerequisite | | | | |
| | MA0111 | | | | |

**PURPOSE:**

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

**INSTRUCTIONAL OBJECTIVES:**

At the end of the Course the students

1. Should have understood maxima and minima of two and three variables
2. Should have been fully exposed to Differential equations and Multiple integrals
3. Should have been able to apply Vector Calculus and three dimensional coordinate Geometry to their branches of Engg.

**FUNCTIONS OF SEVERAL VARIABLES**

Functions of two variables – partial derivatives – total differentiation – Taylor's expansion – maxima and minima of functions of two and three variables – Jacobians

**DIFFERENTIAL EQUATIONS**

Differential equations of first order and higher degree – higher order differential equations with constant coefficients – variable coefficients – method of variation of parameters.

**MULTIPLE INTEGRALS**

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

**VECTOR CALCULUS**

*Review of Vector Algebra.

Gradient, divergence and curl – solenoidal, and irrotational fields – directional derivatives – line integrals – surface integrals – volume integrals, Integral theorem (without proof) and its applications- cubes and parallelopipeds

**THREE DIMENSIONAL ANALYTICAL GEOMETRY**

Direction cosines and direction ratios of a line – angle between two lines. Equation of a plane – equation of straight line – shortest distance between two skew lines – coplanar lines

***No questions should be asked in the Review part**

**TEXT BOOK**

1. Grewal B.S, *Higher Engg Maths*, Khanna Publications, 38th Edition.
2. Veerajan, T., *Engineering Mathematics*, Tata McGraw Hill Publishing Co.,
3. New Delhi, 2000.
4. Dr.V.Ramamurthy & Dr. Sundarammal Kesavan, *Engineering Mathematics – Vol I* & II Anuradha Publications, Revised Edition 2006.

**REFERENCE BOOKS:**


1. Kreyszig.E, *Advanced Engineering Mathematics*, 8th edition, John Wiley & Sons. Singapore, 2001.
2. Kandasamy P etal. *Engineering Mathematics*, Vol.I & II (4th revised edition), S.Chand &Co., New Delhi, 2000.
3. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., *Advanced Mathematics for Engineering students, Volume I & II (2nd edition)*, S.Viswanathan Printers and Publishers, 1992.
4. Venkataraman M.K., *Engineering Mathematics – Vol. III (13th edition*), National Publishing Co., Chennai, 1998.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **PH0102** | **MATERIAL SCIENCE** | **2** | **0** | **2** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The purpose of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials for specific engineering applications.

**INSTRUCTIONAL OBJECTIVES**

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

1. Understand electrical properties of materials,
2. Understand the properties and applications of semi conducting materials,
3. Understand general properties and applications of magnetic and dielectric materials,
4. Understand the behaviour of materials on exposure to light,
5. Understand general properties and application of modern engineering and bio materials, and
6. Get familiarized with the concepts of Nano Science and Technology.

**ELECTRONIC AND PHOTONIC MATERIALS**

**Electronic materials:** Importance of Classical and Quantum free electron theory of metals – Fermi energy and Fermi Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect – Dilute Magnetic Semiconductors (DMS) and their applications – High temperature Superconductivity. **Photonic materials:** LED and LCD materials – Photo conducting materials – Nonlinear optical materials (elementary ideas) and their applications.

**MAGNETIC, DIELECTRIC AND MODERN ENGINEERING MATERIALS**

**Magnetic materials:** Ferrites and garnets – Magnetic bubbles and their applications – Giant Magneto Resistance (GMR) – Colossal Magneto Resistance (CMR). **Dielectric materials:** Various polarization mechanisms in dielectrics (elementary ideas) and their frequency and temperature dependence – Dielectric loss – Piezo electric and ferro electric materials and their applications. **Modern engineering materials:** Shape memory alloys – Metallic glasses – Advanced ceramics and composites.

**BIO MATERIALS**

Classification of biomaterials – Comparison of properties of some common biomaterials – Effects of physiological fluid on the properties of biomaterials – Biological responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials – Introduction to bio sensors and tissue engineering.

**NANO MATERIALS AND NANOTECHNOLOGY**

Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nano materials – Carbon Nanotubes and applications – Material processing by Sol – Gel method, Chemical Vapour deposition and Physical Vapour deposition – Microwave Synthesis of materials – Principles of SEM, TEM and AFM .

**MECHANICAL PROPERTIES OF MATERIALS**

Stress Strain diagram for different engineering materials – Engineering and true stress strain diagram – Ductile and brittle material – Tensile strength – Hardness – Impact strength – Fatigue – Creep – Fracture (Types and Ductile to brittle transition) – Factors affecting mechanical properties.

1. Band gap determination using Post office box.
2. Dielectric constant measurement.
3. Photoconductivity measurement.

4. Resistivity determination for a semiconductor wafer using Four probe method.
5. Determination of Hall coefficient and carrier type for a semiconductor material.
6. To trace the hysteresis loop for a magnetic material.
7. Magnetic susceptibility – Quincke's method.
8. Determination of thermal conductivity – Lee's Disc method
9. Visit to Nano Technology Laboratory (optional)

**TEXT BOOKS**


1. S.O. Kasap, *Principles of Electronic Materials and Devices,* Tata McGraw Hill Edition, New Delhi, 2002.
2. Van Vlack, L.H., *Material Science for Engineers*, 6th edition, .Addision Wesley, 1985.
3. Thiruvadigal, J. D., Ponnusamy, S. and Vasuhi.P. S., *Materials Science*, 5th edition, Vibrant Publications, Chennai, 2007


**REFERENCE BOOKS**


1. Rolf E. Hummel, *Electronic Properties of materials*, Narosa Publishing House, New Delhi, 1994.
2. Raghavan.V, *Materials Science & Engineering – A First Course*, 5th edition, Prentice Hall of India, New Delhi,2005
3. Khanna. O. P., *A Text Book of Material Science & Metallurgy*, Revised edition, Dhanpat Rai Publications, New Delhi,2006.
4. Sujata V. Bhat, *Biomaterials*, 2nd edition, Narosa Publishing House, New Delhi, 2006.
5. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, *Nano Technology – Basic Science and Emerging Technologies*, 1st edition, Overseas Press,New Delhi,2005.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0104** | **PRINCIPLES OF ENVIRONMENTAL SCIENCE** | **2** | **0** | **0** | **2** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

The course provides the comprehensive knowledge in environmental science, environmental issues and the management.

**INSTRUCTIONAL OBJECTIVES**

1. The importance of environmental education, ecosystem and ethics.
2. Knowledge with respect to biodiversity and its conservation.
3. To create awareness on the various environmental pollution aspects and issues.
4. To educate the ways and means to protect the environment.
5. Important environmental issues and protection

**ENIVRONMENT AND ECOSYSTEMS**

Environmental education: definition - scope - objectives and importance. Concept of an ecosystem – types (terrestrial and aquatic ecosystems) – structure and function – ecological succession - food chains, food webs and ecological pyramids

**BIODIVERSITY**

Introduction: definition - genetic, species and ecosystem diversity - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife - endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

**POLLUTION AND WASTE MANAGEMENT**

Air and water pollution – classification of pollutants and their effects – control measures of air pollution. Waste water treatment (general) – primary, secondary & tertiary stages. Solid waste management: causes - effects of municipal waste, hazardous waste, bio medical waste - process of waste management.

**CURRENT ENVIRONMENTAL ISSUES**

Environmental ethics -issues and possible solutions- population explosion, climatic change, ozone layer depletion, global warming, acid rain and green house effect -- Sustainable development: definition, objectives and environmental dimensions of sustainable development- environmental audit for sustainable development.

**ENVIRONMENTAL PROTECTION**
National and international concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

**TEXT BOOKS**
1. Sharma.B.K. and Kaur, "Environmental Chemistry""Goel Publishing House, Meerut, 1994.
2. De.A.K, "Environmental Chemistry", New Age International (p) lt., New Delhi, 1996.
3. Kurian Joseph & R. Nagendran, "Essential of Environmental Studies""Pearson Education, 2004.

**REFERENCE BOOKS**
1. Dara S.S., *A Text Book of Environmental Chemistry and pollution control*, S.Chand & Company Ltd., New Delhi, 2004.
2. Jeyalakshmi.R, *Principles of Environmental Science*, 1st Edition, Devi Publications, Chennai 2006.
3. Kamaraj.P & Arthanareeswari.M, *Environmental Science – Challenges and Changes*, 1st Edition, Sudhandhira Publications, 2007.
4. Arivalagan.K, Ramar.P & Kamatchi.P, *Principles of Environmental Science*, 1st Edition, Suji Publications, 2007.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0102** | **BIOCHEMISTRY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Deals with the study of structural and functional aspects of biomolecules

**INSTRUCTIONAL OBJECTIVES**
1. To study the structure and properties of carbohydrates.
2. Discuss the structure, properties and reactions of proteins and amino acids
3. Discuss the structure, properties of fats and lipids
4. To study the composition, structure and functions of nucleic acids

**CARBOHYDRATES, LIPIDS AND PROTEINS**
Monosaccharides, complex carbohydrates, glycoproteins, lectins, Lipids and cell membranes – types of membrane lipids, phospholipids and glycolipids from bimolecular sheets, Protein structure and function – Primary, Secondary, Tertiary, Quarternary Structures.

**METABOLISM OF CARBOHYDRATES**
Glycolysis, Glucogenesis, Citric acid cycle and Glycogen metabolism

**PROTEIN METABOLISM**
Protein turnover and Amino acid catabolism, Biosynthesis of amino acids

**FATTY ACID METABOLISM AND NUCLEIC ACID METABOLISM**
Overview of Fatty Acid Metabolism, synthesis and degradation of fatty acids, De novo synthesis of Nucleotides

**OXIDATIVE PHOSPHORYLATION**
Oxidative Phosphorylation – regulation – light reactions of Photosynthesis

**TEXT BOOKS:**
1. *Biochemistry* by Jeremy M.Berg, John L.Tymozko, Lubert Stryer, Fifth edition, W.H.Freeman and Company, 1514 pages.

**REFERENCE BOOKS:**
1. *Lehninger Principles of Biochemistry Edition 4*, Nelson, David L. Cox, Michael M. Lehninger, Albert L. W H Freeman & Co

2. *Student Companion to Accompany Biochemistry*, Richard I. Gumport, Jeremy M. Berg, Nancy Counts Gerber, Frank H. Deis, Jeremy Berg, W H Freeman & Co

| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0106** | **BASIC ENGINEERING – II** | **4** | **0** | **0** | **4** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

This course provides comprehensive idea about circuit analysis, working principles of machines and common measuring instruments. It also provides fundamentals of electronic devices, transducers and integrated circuits.

**INSTRUCTIONAL OBJECTIVES**

1. At the end of the course students will be able
2. To understand the basic concepts of magnetic, AC & DC circuits.
3. To explain the working principle, construction, applications of DC & AC machines & measuring instruments.
4. To gain knowledge about the fundamentals of electric components, devices, transducers & integrated circuits.

**PART A ELECTRICAL ENGINEERING**

**ELECTRICAL MACHINES**

Definition of mmf, flux and reluctance, leakage flux, fringing, magnetic materials and B-H relationship. Problems involving simple magnetic circuits.Faraday's laws, induced emfs and inductances, brief idea on Hysteresis and eddy currents. Working principle, construction and applications of DC machines and AC machines (1-phase transformers, 3-phase induction motors, single phase induction motors – split phase, capacitor start and capacitor start & run motors).

**AC & DC CIRCUITS**

Circuit parameters, Ohms law, Kirchhoff's law. Average and RMS values, concept of phasor representation RLC series circuits and series resonance, RLC parallel circuits (includes simple problems in DC & AC circuits) Introduction to three phase systems – types of connections, relationship between line and phase values. (qualitative treatment only)

**WIRING & LIGHTING**

Types of wiring, wiring accessories, staircase & corridor wiring, Working and characteristics of incandescent, fluorescent, SV & MV lamps Basic principles of earthing, simple layout of generation, transmission & distribution of power.

**TEXT BOOKS**

1. Kothari D P and Nagrath I J , Basic Electrical Engineering , Tata McGraw Hill,1991
2. Mehta V K ,Principles of Electronics S Chand & Co,1980

**REFERENCE BOOKS**

1. Kothari D P and Nagrath I J ,Basic Electrical Engineering , Tata McGraw Hill,1991
2. Mithal G K , Electronic Devices and Circuits, Khanna Publications,1997

**PART B ELECTRONICS ENGINEERING**

**ELECTRONIC COMPONENTS AND DEVICES**

Passive components – Resistors, Inductors and Capacitors and their types

**Semiconductor:** Energy band diagram, Intrinsic and Extrinsic semiconductors, PN junction diodes and Zener diodes – characteristics.

**Transistors:** PNP and NPN transistors – theory of operation – Transistor configurations – characteristics – comparison.

**Special semiconductor devices :** FET – SCR – LED – V I characteristics – applications.

**Rectifiers:** Half wave and full wave rectifier – capacitive filter – wave forms – ripple factor – regulation characteristics.

**TRANSDUCERS AND MEASURING INSTRUMENTS**

**Transducers:** General features and classification of transducers, Resistive Transducers – Potentiometer, Unbonded strain gauge-Bonded strain gauge-Load cell, Inductive transducers – Differential output transducers – LVDT, Flow transducers, Temperature Transducers – Thermistors, Thermocouple and pyrometers.

**Measuring Instruments:** Basic principles and classification of instruments, Moving coil and moving iron instruments, CRO – Principle of operation

**DIGITAL ELECTRONICS & LINEAR ICs**

**Digital Fundamentals:** Number systems – Boolean Theorems – DeMorgan's Theorem - Logic gates – Implementation of Boolean Expression using Gates.

**Integrated Circuits:** IC fabrication – Monolithic Technique, Function of Operational Amplifier.

**TEXT BOOKS**


1. Muthusubramanian.R, Salivahanan.S, Muraleedharan.K.A, "*Basic Electrical, Electronics and Computer Engineering"*, Tata McGraw - Hill ,1999.
2. Metha V.K, "*Principles of Electronics* ",S. Chand & Co.,1980.
3. Kalsi H S, "*Electronics Instrumentation*", ISTE publication,1995


**REFERENCE BOOKS**


1. Kothari D. P and Nagrath IJ*, "Basic Electrical Engineering",* Tata McGraw- Hill, 1991.
2. Thomas L.Floyd, *"Electronic devices*", Addison Wesley Longman (Singapore) Pvt . Ltd., 5th Edition.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0104** | **CELL BIOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The course is aimed to make the student understand the basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification

**INSTRUCTIONAL OBJECTIVES**

1. To study cell structure and functions of organelle
2. Exposure on transportations through cell membrane
3. To focus on different receptors and model of signaling
4. To introduce the concept of cell signaling

**AN OVERVIEW OF CELLS AND CELL RESEARCH**

Origin and evolution of cells, cells as experimental models, tools of cell biology – chemistry of cells – molecular composition of cells, central role of enzymes, metabolic energy, biosynthesis of cell constituents, cell membrane.

**CELL STRUCTURE AND FUNCTION – I**

Nucleus, Endoplasmic reticulum, Golgi apparatus and Lysosomes, Bioenergetics and Metabolism – Mitochondria, chloroplasts, Peroxisomes

**CELL STRUCTURE AND FUNCTION – II**

The cytoskeleton and cell movement, cell surface – transport of small molecules, Endocytosis, cell –cell interactions-Adhesion junctions-Tight junctions-Gap junctions- Plasmodesmata

**CELL SIGNALING – CELL REGULATION**

Signaling molecules and their receptors, functions, pathways of intracellular signal transduction – the Cell Cycle –Mitosis and Meiosis –Cell death and cell renewal-Programmed cell death-Stem cells- Embryonic stem cells and therapeutic cloning

**CANCER**
The Development and causes of cancer, tumour viruses, oncogenes, prevention and treatment

**TEXT BOOK:**
*The Cell: A molecular approach* by Geoffrey M.Cooper.ASM Press, Pages: 673

**REFERENCE BOOKS:**
1. *Molecular Biology of the Cell Edition 4*, Roberts, Keith Alberts, Bruce Johnson, Alexander Raff, Martin Walter, Peter Lewis, Julian, Garland
2. *Molecular Cell Biology*, Lodish, Harvey Krieger, Monty Kaiser, Chris A. Berk, Arnold, W H Freeman & Co

| | | L | T | P | C |
|---|---|---|---|---|---|
| **GE0108** | **VALUE EDUCATION** | **1** | **0** | **0** | **1** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**
To provide guiding principles and tools for the development of the whole person, recognizing that the individual is comprised of Physical Intellectual, Emotional and Spiritual dimensions.

**INSTRUCTIONAL OBJECTIVES**

- To help individuals think about and reflect on different values.
- To deepen understanding, motivation and responsibility with regard to making personal and social choices and the practical implications of expressing them in relation to themselves, others, the Community and the world at large.
- To inspire individuals to choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening them.

Value Education—Introduction – Definition of values – Why values? – Need for Inculcation of values – Object of Value Education – Sources of Values – Types
Values:

i) Personal values
ii) Social values
iii) Professional values
iv) Moral and spiritual values
v) Behavioral (common) values

Personal values – Definition of person – Self confidence – Self discipline – Self Assessment – Self restraint – Self motivation – Determination – Ambition – Contentment – Humility and Simplicity - Sympathy and Compassion – Gratitude -Forgi

Social values – Definition of Society – Units of Society - Individual, family, different groups – Community – Social consciousness – Equality and Brotherhood – Dialogue – Tolerance – Sharing – Responsibility – Co-operation Freedom – Repentance and Magnanimity.

Professional values – Definition – Competence – Confidence – Devotion to duty –Efficiency – Accountability – Respect for learning /learned – Willingness to learn-Open and balanced mind – Team spirit – Professional Ethic – Willingness for Discussion – Aims – Effort – Avoidance of Procrastination and slothfulness –Alertness.

Behavioral values – Individual values and group values – Good manners at home and outside – Equality – Purity of thought, speech and action – Understanding the role of religion – Faith – Understanding the commonness of religions – respect for other faiths – unity in diversity – Living together – Tolerance – Non-violence – Truthfulness – Common aim – Unified effort towards peace – Patriotism.

**REFERENCE BOOKS**

1. Dr. S. Ignacimuthu S. J., Values for life, *Better yourself Books*, Bandra Mumbai-600 050 (1999).
2. Values(Collection of Essays)., Published by : Sri Ramakrishna Math., Chennai—4.,(1996)

3. Prof. R.P.Dhokalia., Eternal Human Values NCRT –Campus Sri Aurobindo Marg., New Delhi - 110 011.
4. Swami Vivekananda., Education., Sri Ramakrishna Math., Chennai-4(1957)
5. Tirukural (English Translation by Dr.G.U.Pope).
6. The Bible
7. The Kuran
8. The Bhagavath Geetha

| | | L | T | P | C |
|---|---|---|---|---|---|
| **ME0120** | **WORKSHOP PRACTICE** | **0** | **0** | **4** | **2** |
| | Prerequisite | | | | |
| | Nil | | | | |

**PURPOSE**

To provide the students with hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal

**INSTRUCTIONAL OBJECTIVES**

To familiarize with

1. The basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy.
2. The production of simple models in the above trades.

**LIST OF EXPERIMENTS**

**EMPHASIS TO BE LAID ON REAL LIFE APPLICATIONS WHEN FRAMING THE EXERCISES.**

**FITTING**

Tools & Equipments – Practice in Filing and Drilling.
Making Vee Joints, Square, dovetail joints, Key making.

**CARPENTRY**

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.

**SHEET METAL**

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc

**WELDING**

Tools and equipments - Arc welding of butt joint, Lap Joint, Tee Fillet. Demonstration of Gas welding, TIG & MIG

**SMITHY**

Tools and Equipments –Making simple parts like hexagonal headed bolt, chisel.

**TEXT BOOKS**

1. Gopal, T.V., Kumar, T., and Murali, G., *"A first course on workshop practice – Theory, practice and work book"*, Suma Publications, 2005.

**REFERENCE BOOKS**

1. Kannaiah,P. & Narayanan,K.C. *Manual on Workshop Practice*, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V.S. *First year Engineering Workshop Practice*, Ramalinga Publications, Madurai, 1999.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **CS0140** | **COMPUTER PRACTICE** | **1** | **0** | **2** | **2** |
| | Prerequisite | | | | |
| | Nil | | | | |

**Common For All Branches Except ME, AU, MH, AS, CS and IT**

**PURPOSE:**
To introduce programming languages C and C++ as tools to solve problems and to provide hands on training

**INSTRUCTIONAL OBJECTIVES:**
After completing the course, the students should be able to

- Understand the program development life cycle
- Design algorithms to solve simple problems using computers
- Convert algorithms into C and C++ programs and execute

**PROGRAMMING FUNDAMENTALS**
Computer Basics; Program Development Life Cycle: Flow Chart, Algorithm, Compilation and Execution; Introduction to C Language: program structure, variables, keywords, data types; Input / Output functions: scanf, printf; simple programs.

**DECISION AND LOOP CONTROL STRUCTURE**
Logical operators; Decision statements: if/else, switch/case statements; Loop control statements – for, while, do/while.

**ARRAYS AND FUNCTIONS**
**Arrays:**
Introduction to arrays; one dimensional arrays: declaration , reading and printing array elements, sorting and searching.
**Functions:**
Definition; declaration of functions; return statement; recursion.

**INTRODUCTION TO OOP CONCEPTS**
OOP concepts: data hiding, encapsulation, inheritance, overloading, polymorphism; classes and objects; constructor and destructor; simple program in C++.

**INHERITANCE AND OVERLOADING**
Inheritance – single, multiple, multilevel; overloading – Function overloading, Operator overloading.

**List of Exercises:**

**Note to the Instructors: Design exercise problems to demonstrate the use of C and C++ in the area of specialization.**

1. Programs to demonstrate the use of scanf( ) and printf( ) functions
2. Programs to evaluate arithmetic expressions
3. Programs using conditional statements
4. Programs using for,while , do…while
5. Programs on arrays
6. Programs to perform matrix addition and multiplication
7. Programs to implement functions
8. Programs to illustrate recursion
9. Program to create classes and objects using C++
10. Program to implement Constructor and Destructor in C++
11. Program to implement single inheritance in C++
12. Program to implement Function overloading in C++
13. Program to implement Operator overloading in C++

**REFERENCE BOOKS**

1. *Computer Practice Laboratory Manual*, SRM University
2. Kanetkar P.Yashwant,*"Let us C",* BPB publications, 2002.

3. Ashok N.Kamthane, *"Programming with ANSI and Turbo C"*, Pearson Education, 2006.
4. Herbert Schildt, *"The Complete Reference C++"*, TataMcGrawHill, 2001, 3rd Edition.
5. Robert Lafore, *"Object Oriented Programming in Microsoft C++"*, The Waite Group, Galgotia Publications Pvt. Ltd., 2002.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0108** | **BIOCHEMISTRY LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTIONAL OBJECTIVES**
The students should be able to understand and develop their skills in
1. Accuracy and Precession of analysis
2. Qualitative testing of Carbohydrates
3. Identification of amino acids and proteins
4. Quantitative analysis of nucleic acids and enzymes.

**LIST OF EXPERIMENTS**
1. pH measurements and preparation of buffers.
2. Qualitative tests for Carbohydrates.
3. Estimation of sugars.
4. Estimation of proteins by Lowry's method / Biuret method.
5. Estimation of cholesterol by Zak's method.
6. Determination of saponification number of lipids.
7. Estimation of Amino acids.
8. Separation of amino acids - Thin layer chromatography.
9. Separation of sugars - Paper chromatography
10. Biochemical estimation of DNA /RNA using Spectrophotometer

**REFERENCE BOOKS:**
*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD0102** | **PERSONALITY DEVELOPMENT - II** | **0** | **0** | **2** | **0** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**
1. To guide thought process.
2. To groom students' attitude.
3. To develop communication skill.
4. To build confidence.

**METHODOLOGY**
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.

4. Ensure Participation.
5. Empirical Learning

Puzzles I - Poster design/Caption/Slogan writing (Social issues) - Bone of contention I – debate

Bone of contention II - Puzzle II - Survey and Reporting (favorite channel, music, food)

Interpretation of Visuals of I & II - Vocabulary games III

Book Review - Quiz I - Presentation Skills I

Presentation Skills II - Analytical Thinking – Review

**EVALUATION**
1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

**SCHEME OF INSTRUCTION**
Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**
Complete Internal evaluation on a Regular Basis

**SEMESTER III**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0201** | **ENZYME TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Provides an opportunity to understand the theoretical concepts of enzyme technology principles in a more explicit and concentrated manner

**INSTRUCTIONAL OBJECTIVES**
1. To understand the different types of enzymes
2. Enzyme purification,
3. mechanisms of action of enzymes
4. Techniques of enzyme immobilization

**INTRODUCTION TO ENZYMES**
Classification of enzymes, specificity of enzyme action – monomeric and oligomeric enzymes,-Factors modifying enzyme activity, biotechnological applications of enzymes and applications of enzymes in various industries.

**CHEMICAL NATURE OF ENZYME CATALYSTS**
Structural Components of Enzymes – Structure, apoenzymes, prosthetic group, cofactors, Mechanisms of reactions catalysed by enzymes – Metal activated enzymes – metalloenzymes –involvement of co enzymes.

**FREE AND IMMOBILISED ENZYME KINETICS**
Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, presteady state kinetics, Kinetics of multi-substrate reactions, Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model, Temperature and pH effects on enzyme activity. Methods of immobilization of enzymes, Kinetics of immobilized enzymes – Effects of external mass transfer and intra – particle diffusion.

**EXTRACTION AND PURIFICATION OF ENZYMES**
Methods of production of enzymes, Extraction of Enzymes –soluble enzymes – membrane bound enzymes – Nature of extraction medium – purification of enzyme – criteria of purity **–** Determination of molecular weight of enzymes.

**INSTRUMENTAL TECHNIQUES IN ENZYMATIC ANALYSIS**
Principles – Manometry – Spectrophotometry – Spectrofluorimetry – Electrochemical methods – Enthalpimetry – Radio chemical methods – Automation in enzymatic analysis.

**TEXT BOOKS**

*1* **.** *Enzymes* by Trevor palmer
*2* **.** *Enzymes* by Robert A. Copeland, 2nd edition.
*3. Biochemical Engineering* by Harwey W. Blanch and Douglas S. Clark

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0203** | **GENETICS AND CYTOGENETICS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course introduces the fundamentals of genetics. It discusses the basic laws of chromosome structure, sex linked chromosomes and inherited disorders, identification of genetic material and genetic transfer.

**INSTRUCTIONAL OBJECTIVES**
To introduce and discuss the
1. Fundamental laws of genetics
2. Types of blood groups and antigen
3. Concept of sex chromosome, links, disorders and gene mapping
4. Methods of identification of genetic material
5. Types of genetic transfer

**MENDELIAN GENETICS**
Mendel's experiments, principles of segregation – monohybrid cross – Independent Assortment, Gene interaction, multiple alleles.

**CHROMOSOME STRUCTURE AND ORGANIZATION**
Chromosome structure and organization in prokaryotes and eukaryotes, Giant chromosomes – polytene and lampbrush – sex determination and sex linkage.

**LINKAGE AND CROSSING OVER**
Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization

**VARIATION IN CHROMOSOME STRUCTURE AND NUMBER**
Deficiencies – duplication –inversion- translocation – positive effects-human chromosome techniques (karyotyping)- chromosome aberration in humans-classification of mutation- classification of ploidy, -variation in chromosome number-extra chromosomal inheritance-cytogenetical abnormalities in humans

**RECOMBINATION IN BACTERIA**
Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes- plasmids and episomes

**TEXT BOOK:**
*Principles of Genetics* by Gardner, Simmons, Snustad, 8th edition – John Wiley and Sons, Inc., 2003

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0205** | **IMMUNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Aimed at introducing the science of immunology and detail study various types of immune systems their classification structure and mechanism of immune activation**.**

**INSTRUCTIONAL OBJECTIVES**

1. The immune system, their structure and classification, genetic control of antibody production
2. Cellular immunology
3. Mechanism of activation in hypersensitive immune reaction

**OVERVIEW OF THE IMMUNE SYSTEM**

Innate Immunity- adaptive immunity- comparative immunity cells and organs the immune system – Antigens.

**IMMUNOGLOBULIN STRUCTURE AND FUNCTIONS**

Basic structures of Immunoglobulins – I g classes and biological activities, Antigenic determinants on Ig- B Cell receptor, Monoclonal antibodies – cytokines – complement system

**ANTIGEN – ANTIBODY INTERACTIONS**

Antibody Affinity and activity – Precipitation reactions- agglutination reactions- Radio immunoassay-ELISA-Western blotting, Immunoprecipitation, Immunofluroscence, immunoelectron microscopes, flow cytometers-MHC Antigen processing & presentations.

**T CELL & B CELL MATURATION, ACTIVATION & DIFFERENTIATION**

T Cell receptor- T Cell maturation, activation and differentiation B Cell generation- activation and differentiation cell mediated effectors responses.

**IMMUNE SYSTEM IN HEALTH & DISEASE**

Leukocyte migration and inflammation - hypersensitive reactions - immune response to infection diseases - vaccines.

**TEXT BOOK**


1. Richard A. Golds, Tharmas J. Kindt, *Kuby Immunology*, Barbara Osborne. W.H. Freeman and company, fourth edition 2000.
2. A. K. Chakravarty, *Immunology and Immunotechnology*, Oxford University Press, 2006.


## REFERENCE BOOKS


1. Charles Janeway, *Immunobiology: The Immune System in Health and Disease*, Garland Science, 2005.
2. Richard Coico, Geoffrey Sunshine, *Immunology: A Short Course*, John Wiley & Sons, 2007.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0207** | **MICROBIOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Introducing the fundamentals of microbiology through the study of the characteristics of microorganisms, multiplication, growth in different media, metabolic pathways, effects of microbe and their control.

**INSTUCTIONAL OBJECTIVES**

1. To highlight the roles and characteristics of microorganisms
2. To impart knowledge on the basic concept of replication in microorganisms
3. To study in detail the growth of microorganisms and impact of environment on their growth

4. To evaluate explicitly, the metabolic pathways, role of microbes in public health; insight into the physical and chemical control of microorganisms.

**INTRODUCTION TO MICROBIOLOGY**

Characterization, Classification and Identification of microorganisms - Microscopic examination of Micro organisms morphology and fine structure of bacteria- cultivation of bacteria - reproduction & growth, pure cultures and cultural characteristics.

**MICROBIAL PHYSIOLOGY AND GENETICS**

Enzymes and their regulation- Microbial metabolism energy production- utilization of energy & biosynthesis - bacterial genetics.

**MICROBIAL PHYSIOLOGY AND GENETICS**

Fungi – importance, characteristics, morphology, reproduction, physiology cultivation & classification of fungi, molds & repair association with other organisms. Algae – importance of algae – characteristics of algae, classification protozoa: Ecology, importance, morphology, reproduction and classification of protozoa – control of microorganisms.

**VIRUSES OF BACTERIA, ANIMAL AND PLANTS**

Bacteriophages- General characteristics-Morphology and structure, Classification and Nomenclature-Bacteriophages of *E. coli* – Replication -viruses of plants and animals- Structure- Replication- Classification-isolation and identification-fatal diseases associated with viruses in animals-viroids

**ENVIRONMENTAL AND INDUSTRIAL MICROBIOLOGY**

Microbiology of soil – aquatic microbiology-Microbiology of domestic water and waste water- Microbiology of fuel and Industrial microbiology

**TEXTBOOKS**

1. Pelczar, JR E.C.S Chan and Noel R. Krieg, *Microbiology*, Fifth edition Tata McGraw Hill, 2006.
2. Prescott, Harley and Klen, *Microbiology*, McGraw Hill publications Fifth edition, 2003.

**REFERENCE BOOKS**

1. Kathleen Park Talaro, *Foundations in Microbiology:Basic Principles* ,McGraw-Hill, 2006.

| CH 0205 | CHEMICAL PROCESS CALCULATIONS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course prepares the students to formulate and solve material and energy balances on chemical process systems.

**INSTRUCTIONAL OBJECTIVES**

To familiarize:

1. Basic principles of process calculations,
2. Material balance calculations,
3. Combustion calculations,
4. Humidity calculations,
5. Energy balance calculations.

**INTRODUCTION**

Units and dimensions, the mole unit, mole fraction (or percent) and mass fraction (or percent), analyses of a mixture, concentrations, basis of calculations, predicting P-V-T properties of gases using the following equations of state: ideal gas law, Van der Waals equation, Redlich-Kwong equation, calculation of density.

**CHEMICAL EQUATION AND MATERIAL BALANCES**
Basics of chemical equation and stoichiometry, limiting reactant, excess reactant, conversion, selectivity, yield. Basic concepts involved in material balance calculations, material balance problems without chemical reactions: membrane separation, mixing, drying, crystallization. Basic concepts of recycle, bypass and purge streams.

**COMBUSTION**
Introduction, flue gas, Orsat analysis, theoretical air, excess air, determination of products of combustion of solid, liquid and gaseous fuels, calculation of excess air.

**PARTIAL SATURATION AND HUMIDITY**
Definition of saturated gas, partial saturation, dew point, Definition and calculation of the following by formulae involving partial pressures of gas components: molal humidity, humidity, saturation molal humidity, saturation humidity, percentage humidity, relative humidity. Material balances involved in the following processes: dehydration, humidification, condensation.

**ENERGY BALANCES**
Thermodynamics: Heat capacity of gases, empirical equations for heat capacities, mean heat capacities of gases, Kopp's rule, latent heats, calculation of enthalpy from thermophysical properties.-Thermochemistry: Standard heat of reaction, heat of formation, law of Hess, standard heat of combustion, heats of formation calculated from heats of combustion, calculation of the standard heat of reaction from heats of formation or combustion, effect of temperature on heat of reaction, enthalpy changes in reactions with different temperatures, calculation of theoretical flame temperature.

**TEXT BOOKS**

1. David M. Himmelblau, "*Basic Principles and Calculations in Chemical Engineering*", 6th Edn., Prentice-Hall of India, New Delhi, 1998.
2. Hougen,O.A., Watsen, K.M., and R.A. Ragartz, "*Chemical Process Principles*", part-I, John Wiley and Asia Publishing Co., 1976.


**REFERENCE BOOKS**

1. Richard M. Felder, Ronald W. Rousseau, "*Elementary Principles of Chemical Processes*", 3rd Edition by John Wiley & Sons, Inc. Singapore, 2000.
2. Bhatt B.I. and Vora S.M., "*Stoichiometry*", 3rd Edn., Tata McGraw-Hill Publishing Co., New Delhi, 1996.


| CH 0215 | MECHANICAL OPERATIONS & HEAT TRANSFER | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course is concerned with filtration and agitation operations & modes of heat transfer and their applications.

**INSTRUCTIONAL OBJECTIVES**
To familiarize:
1. Filtration operation,
2. Agitation and mixing of liquids,
3. Heat conduction phenomena,
4. Convective heat transfer phenomena,
5. Heat exchange equipments.

**FILTRATION**
Introduction, cake filters, discontinuous pressure filter: principle and working of filter press, continuous vacuum filter: principle and working of rotary drum filters, centrifugal filter: principle and working of suspended batch centrifuges, filter media, filter aids, principles of cake filtration, pressure drop through filter cake, compressible and incompressible filter cakes, filter-medium resistance, constant pressure filtration, continuous filtration, constant rate filtration, working principle of centrifugal filters.

**AGITATION AND MIXING OF LIQUIDS**
Units and dimensions, dimensional analysis: Buckingham's $\pi$ theorem. -Principles of agitation, agitation equipment, flow patterns: prevention of swirling, draft tubes. Standard turbine design, power consumption, power correlation, significance of dimensionless groups, effect of system geometry, calculation of power consumption in Newtonian liquids. Blending and mixing: blending of miscible liquids, blending in process vessels, stratified blending in storage tanks, jet mixers, motionless mixers, mixer selection.

**HEAT CONDUCTION**
Introduction to various modes of heat transfer, Fourier's law of heat conduction, effect of temperature on thermal conductivity, steady-state conduction, compound resistances in series, heat flow through a cylinder, critical radius of insulation in pipes.

**CONVECTIVE HEAT TRANSFER**
Heat flux, average temperature of fluid stream, overall heat transfer coefficient, LMTD, individual heat transfer coefficients, relationship between individual and overall heat transfer coefficients.-Concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, heat transfer to fluids without phase change: heat transfer coefficient calculation for natural and forced convection, heat transfer to fluids with phase change: heat transfer from condensing vapours, dropwise and film-type condensation, heat transfer coefficients calculation for film-type condensation.

**HEAT-EXCHANGE EQUIPMENT**
Typical heat exchange equipment, counter current and parallel-current flows, enthalpy balances in: heat exchanges, total condensers. -Double pipe exchanger, single-pass 1-1 exchanger, 1-2 parallel-counterflow exchanger, 2-4 exchanger, heat-transfer coefficients in shell-and-tube exchanger, coefficients for crossflow, correction of LMTD for crossflow.-Condensers: shell-and-tube condensers, kettle-type boilers,
Calculation of number of tubes in heat exchangers.

**TEXT BOOK**
1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "*Unit Operations of Chemical Engineering*", 6th Edn., McGraw Hill International Edition, NewYork 2001.

**REFERENCE BOOKS**
1. Narayanan C.L.& Bhattacharya, "*Mechanical Operation for Chemical Engineering*",1993.
2. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "*Coulson & Richardson's Chemical Engineering*", Vol. II, 4th Edn., Butter worth Heinemann, Oxford, 1996.
3. Donald Q. Kern, "*Process Heat Transfer*", Tata McGraw Hill Book Co., New Delhi, 1997.

| | | L | T | P | C |
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| **LE0201** | **GERMAN LANGUAGE PHASE I** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Enabling the Engineering Students to one more Foreign Language, especially German, which is scientific and technical language. This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites.

**INSTRUCTIONAL OBJECTIVES**
Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own C V and developing a fundamental conversation with any German national.

**INTRODUCTION**
German Language, Alphabets and Pronunciation

**THEMEN**
Name, Land, Leute, Beruf, Familie geschwister, Einkaufen, Reisen, Zahlen, Haus, Freunden, Essen and Stadium, Fest, Zeit.

**LISTENING**

Listening to the cassette and pay special attention to the meaning and sounds. Listening Comprehension – Announcements / Airport / Station / General

**READING**
Listening to the cassette and reading it allowed.
READING COMPRENSION BASICS / STATION / NEWS / NOTICE BOARDS.

**GLOSSARY**
Technical Words Lesson (1-5)

**TEXT BOOK WITH CASSETTES**

1. *Grundkurs Deutsch*
2. *Momentmal (*Max Mueller Bhavan – Goethe Institute, Germany).

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0203** | **JAPANESE LANGUAGE PHASE I** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
1. In view of globalization, learning Foreign Language by Engineering graduates enhances their employment opportunities.
2. Get awareness of understanding of International culture.
3. Widening the Linguistic Skills of the Students.

**INSTRUCTIONAL OBJECTIVES**
To learn the scripts of Japanese Languages namely Hiragana, Katakana and Kanji, Vocabularies etc. To learn basic grammar and acquire basic communication skills. To understand Japanese culture.

Alphabets (Hiragana), Self Introduction, Greetings, Classroom expressions, Numbers,
Conversation

Alphabets Hiragana (continued), Vocabularies.
Counters, Time expression, Conversation

Katakana and related vocabulary
Kanjis –introduction, conversation.

Lesson-1 Watashiwa Nihonjin desu. Grammar,Marume &Sentence pattern.Marume
Conversation

**TEXT BOOKS**
1. Nihongo Shoho I main Text sold in India by the Japanese Language Teachers Association Pune.
2. Hiragana and Katakana Work Book published by AOTS Japan
3. Grammar and Kotoba ( Work Book )
4. Japanese for Dummies.(Conversation) CD.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0205** | **FRENCH LANGUAGE PHASE I** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
1. As language skills are as valuable as technical skills a knowledge of French enables the engineering graduates in career orientation.
2. As a second international global Lang after English there is a wider choice of job opportunities in the inter national employment market and also multinationals in India and an understanding of French culture thro language.

**INSTRUCTIONAL OBJECTIVE**
Characterised by the Roman script, grammar, vocabulary and colloquial expressions are taught which enables them to communicate effectively with any native speaker.

**INTRODUCTION AND PRONUNCIATION**
Introduction of the French Language, Alphabets and Pronunciation, Greetings (Wishing, Thanking and Bidding good bye), Introducing oneself & someone Presenter quelqu'un et se presenter - conversational French sentences based on the topics discussed above.

**VOCABULARY**
Numbers and Dates, Days, Months and Seasons, Time, Nouns, Professions and Nationalities. Conversational sentences on weather, time, and professions.

**GRAMMAR**
Basic Verbs (Avoir, Etre, Aller, Faire) – Conjugation – Present tense, Affirmative, Negative, Interrogative, Adjectives (Qualitative), Subject Pronouns and Disjunctive Pronouns.

**CONVERSATION AND LISTENING**
Conversational sentences on physical description and expressions with verbs like avoir, etre and faire

**GRAMMAR**
Prepositions ( a, de,dans, en, sur,sous, pour….),Contracted Articles, Question Tag (Qui, Quel, Ou, ……etc)

**TEXT BOOKS :**
1. Panorama – Goyal Publishers
2. Apprenons le Francais I, Sarawathy publication.

**SCHEME OF EVALUATION**

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0217** | **COMPUTER SKILLS** | **1** | **0** | **2** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
To acquire extramural knowledge on the computer implementation of various engineering solutions.

**IMPLEMENTATION**
The students are expected to undergo at least two computer courses from a list of courses provided from time to time by the departments of engineering and technology. Resources for conducting the courses will be found from in-house talents and outside professionals with expertise in the particular course. Certification will be done by both the university and the bodies notified for the purpose. The students are required to obtain a minimum grade for gaining the required credit

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0211** | **MICROBIOLOGY LABORATORY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTONAL OBJECTIVES**
The students should be able to
1. Understand explicitly the concepts
2. Develop their skills in the preparation, identification and quantification of microorganisms

**LIST OF EXPERIMENTS**

1. Sterilization techniques
2. Media preparation
3. Microscopy and Micrometry
4. Isolation, enumeration and purification of microbes from a given sample
5. Staining Techniques (Simple, Gram staining, spore staining )
6. Motility test by Hanging drop method
7. Biochemical Characterization of Bacteria
   - Oxidation/Fermentation Test
   - Catalase, Oxidase and Urease Tests
   - IMViC test
   - Hydrogen Sulfide Test and Nitrate Reduction Test.
   - Casein and Starch Hydrolysis

7. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
8.. Growth Kinetics (Bacterial Growth Curve)
9. Isolation of antibiotics producing bacteria
10. Isolation and characterization of plant microbes

**REFERENCE BOOK**

*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0213** | **CELL BIOLOGY LABORATORY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTONAL OBJECTIVES**

The students should be able to

1. Understand explicitly the concepts
2. Develop their skills in the preparation and identification of cell structures and their functions

**LIST OF EXPERIMENTS**

1.Microscopic study of cell and cell organelles
2. Cell fractionation
3. Fixation, Dehydration, embedding and sectioning of tissues
4.Histology of extracellular matrix
5.Quantitative analysis of lipid classes by TLC
6. Isolation of microtubules
7. Isolation of actin and Myosin filaments
8.Isolation of Mitochondria
9. Nuclear staining
10. Stages of cell cycle.

**REFERENCE BOOK**

*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0215** | **IMMUNOLOGY LABORATORY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **BT0104 CELL BIOLOGY** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner

**INSTRUCTIONAL OBJECTIVES**
The students should be able to develop their skills

1. Isolation of antibodies
2. Purification of antibodies
3. Immunoelectrophoresis

**LIST OF EXPERIMENTS**

1. Blood grouping
2. Leukocyte count
3. PBMC preparation and their enumeration
4. Production of polyclonal antibodies – preparation of antigen – protocol for immunization in rabbits
5. Methods of bleeding-purification of polyclonal antibodies
6. Antigen-antibody reaction-Haemagglutination, precipitation-Widal and VDRL
7. Immunodiffusion, Immunoelectrophoresis.
8. Affinity chromatography for antibody purification.
9. ELISA-DOT and plate ELISA
10. Western blotting

**REFERENCE BOOK**
*Laboratory manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD 0201** | **PERSONALITY DEVELOPMENT -III** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**
1. To guide thought process.
2. To groom students' attitude.
3. To develop communication skill.
4. To build confidence.

**METHODOLOGY**
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Goal Setting - Problem Solving - Emotional Quotient
Assertiveness - Stress Management - Quiz II
Lateral Thinking (Situational) - Team Work (Role Plays) Impromptu - Text Analysis
Business plan presentation I - Business plan presentation II - Chinese Whisper
Picture Perfect - Case Studies – Review

**SCHEME OF INSTRUCTION**
Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**
Complete internal evaluation on a regular Basis

## SEMESTER IV

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0202** | **MOLECULAR BIOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This subject discusses the fundamentals concepts and basic principles such as structure of DNA / RNA, transcription, translation gene regulation, and RNA splicing.

**INSTRUCTONAL OBJECTIVES**

To impart knowledge on Nucleic acids and their characteristics, transcription, translation, protein sorting, regulation of gene expression

**INTRODUCTION TO MOLECULAR BIOLOGY - DNA AND RNA**

Scope and History, Structure of DNA-Nucleoside, Nucleotide, Base pairing, Base stacking, Double Helix, features of Watson and Crick model, major and minor groove, Supercoiling- twist, writhe and linking number. Forms of DNA- A, B, Z Structure and function of mRNA, rRNA, tRNA Secondary structures in RNA

**REPLICATION AND REPAIR**

Types and functions of DNA polymerases in Prokaryote and Eukaryote Replication in prokaryote and Eukaryote Proof reading activity, 5'→ 3' exonuclease activity, topoisomerase activity, Telomeric DNA replication and Plasmid Replication-theta model, strand displacement model and rolling circle model DNA Repair- Nucleotide excision repair, base excision repair, mismatch repair, photo-reactivation, recombination repair and SOS repair.

**TRANSCRIPTION AND POST TRANSCRIPTIONAL MODIFICATIONS**

Fine structure of prokaryotic and eukaryotic gene, structure and function of the promoters in mRNA, rRNA, tRNA genes RNA polymerases in prokaryote and eukaryote, types and function Transcription of mRNA, rRNA, and tRNA genes in Prokaryote and eukaryote Post transcriptional processing of mRNA – 5'capping, splicing (including different types), polyadenylation and RNA editing.

**TRANSLATION AND POST TRANSLATIONAL PROCESSING**

Genetic code and Wobble hypothesis Translation in prokaryote and eukaryote Post translational modifications. Principles protein sorting and targeting into endoplasmic reticulum, mitochondria, chloroplast, and nucleus

**GENE REGULATION**

Principles of gene regulation- Transcriptional and post transcriptional gene regulation-activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers Operon-*lac* operon, *trp* operon, *ara* operon and *gal* operon.

**TEXT BOOKS:**

1. *Molecular Biology of Gene* - Watson
2. *Molecular and Cellular Biology*- Stefen Wolfe

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0204** | **BIOPROCESS PRINCIPLES** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This subject puts emphasis on the basic engineering principles of bioprocess. It also highlights the modern application of biotechnological process and the role of bio process engineer in biotechnological industry.

**INSTRUCTIONAL OBJECTIVES**

1. To study the historical development of bio process technology design and construction of fermentor and parameters to be monitored and controlled in fermentation process
2. To evaluate the kinetics and thermodynamics of enzymatic process

3. To teach the principle of sterilization design
4. To study the stoichiometry and energetics of cell growth and product formation
5. To evaluate the kinetics and mechanism of microbial growth

**INTRODUCTION TO BIOPROCESS**
Historical development of bioprocess technologies, role of bioprocess engineer in the biotechnology industry, concept of Bioprocess, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets. A brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology.

**FERMENTATION PROCESS**
General requirements of fermentation processes; Isolation, preservation and improvement of industrially important micro- organisms, development of innocula for industrial fermentations. Different types of fermentations, Basic design and construction of fermentor and ancillaries, An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry solid-substrate fermentation and its applications.

**METABOLIC STOICHIOMETRY AND ENERGETICS**
Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass available, electron balances, yield coefficient of biomass and product formation, maintenance coefficients, energetics analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**MEDIA DESIGN AND STERILIZATION FOR FERMENTATION PROCESS**
Designing of media for fermentation processes, Types of media, design and usage of various commercial media for industrial fermentations, thermal death kinetics of micro organisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air, design of sterilization equipment.

**UNIT 5 KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION**
Phases of cell growth in batch cultures, simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudking – Piret models, substrate and product inhibition on cell growth and product formation.

**REFERENCE BOOKS:**
1. Pauline.M.Doran ., "*Bioprocess Engineering Principles*";Academic press ..
2. Peter F.Stanbury, Allan Whitaker, "*Principles of Fermentation Technology*"
3. Michael L.Shuler and Fikret Kargi, "*Bioprocess Engineering Basic concepts*", Prentice Hall, 1992.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0206** | **BIOPHYSICS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
To introduce the theories and concepts of biophysics of biomolecules which are considered important in biotechnology applications

**INSTRUCTIONAL OBJECTIVES**
1. Learn the structures of biological molecules
2. To understand the concept of structural analysis
3. Learn the techniques for analysis and determination of structure of biomolecules

**STRUCTURES OF BIOLOGICAL MACROMOLECULES**
Levels of structures in proteins, nucleic acids and polysaccharides - primary, secondary, tertiary and quaternary structures

**CONFORMATIONAL ANALYSIS OF PROTEINS: PROTEIN STRUCTURE**
Polypeptide chain geometries, internal rotation angles, Ramachandran plot, potential energy calculations, forces that determine protein structure – hydrogen bonding, hydrophobic interactions, ionic interactions, disulphide bonds – prediction of protein structure.

**CONFORMATIONAL ANALYSIS OF NUCLEIC ACIDS**
General characteristics of nucleic acid structure – geometric – Glycosidic bond – rotational isomers, ribose puckering – backbone rotation angles and steric hindrances – forces stabilizing ordered forms – base pairing and base stacking

**TECHNIQUES FOR THE STUDY OF BIOLOGICAL STRUCTURE**
Electron Microscopy, Ultracentrifuge, Viscometry, Molecular –sieve chromatography, electrophoresis, NMR and EPR.

**OTHER TECHNIQUES**
X-Ray crystallography, X-ray fiber diffraction, light scattering, Neutron scattering

**TEXT BOOK:**
*Biophysical Chemistry*, Cantor and Schimmel, part I and II, W.H. Freeman and co 1997.

| **CH 0206** | **MOMENTUM TRANSFER** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | **(Same as CH 0213)** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course deals with behavior of fluids.

**INSTRUCTIONAL OBJECTIVES**
To familiarize:
1. The basic concepts and fluid-flow phenomena,
2. Kinematics of flow,
3. Phenomena of flow past immersed bodies,
4. Various aspects of transportation of fluids,
5. Various aspects of metering of fluids.

**FLUID FLOW PHENOMENA**
Nature of fluids: incompressible and compressible, hydrostatic equilibrium, manometers, potential flow, boundary layer, the velocity field, laminar flow, Newtonian and non-Newtonian fluids, Newton's-law of viscosity, turbulence, Reynolds number and transition from laminar to turbulent flow, Eddy viscosity, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary-layer formation in straight tubes..

**KINEMATICS OF FLOW**
Streamlines and stream tubes, equation of continuity, Bernoulli equation, pump work in Bernoulli equation.
Flow of incompressible fluids in conduits and thin layers: friction factor, relationships between skin-friction parameters, average velocity for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, hydraulically smooth pipe, von Karman equation, roughness parameter, friction-factor chart, equivalent diameter, form friction losses in Bernoulli equation, couette flow.

**FLOW PAST IMMERSED BODIES**
Drag, drag coefficients, drag coefficients of typical shapes, Ergun equation, terminal settling velocity, free and hindered settlings, Stokes' law, Newton's law, criterion for settling regime, fluidization, conditions for fluidization, minimum fluidization velocity.

**TRANSPORTATION OF FLUIDS**
Introduction to: pipe and tubing, joint and fittings, stuffing boxes, mechanical seals, gate valves and globe valves, plug cocks and ball valves, check valves.-Classification and selection of pumps, blowers and compressors. -Pumps: developed head, power requirement, suction lift and cavitation, NPSH, constructional features and working principle of single suction volute centrifugal pump, characteristic curves of a centrifugal pump, comparison of devices for moving fluids, constructional features and working principle of jet ejectors.

**METERING OF FLUIDS**

Constructional features and working principles of: venturi meter, orifice meter, rotameters, pitot tube, target meters, vortex-shedding meter, turbine meter, magnetic meters.-Application of Bernouli equation to venturi meter and orifice meter, flow rate calculations from the readings of venture meter, orifice meter and pitot tube.

**TEXT BOOK**

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "*Unit Operations of Chemical Engineering*", 6th dn., McGraw Hill International Edition, NewYork 2001

**REFERENCE BOOKS**

1. Coulson J.M., Richardson J.F., Backhurst J.R. and Harker J.M., "*Coulson & Richardson's Chemical Engineering*", Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999.
2. Noel de Nevers, "*Fluid Mechanical for chemical Engineers*", 2nd Edn., McGraw Hill International Editions, 1991.

| CH0216 | CHEMICAL ENGINEERING THERMODYNAMICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course helps the students to obtain a proficiency in applying thermodynamic principles to the solution of a variety of energy flow and equilibrium problems.

**INSTRUCTIONAL OBJECTIVES**

To familiarize:

1. Basic concepts and first law of thermodynamics,
2. Volumetric properties of pure fluids,
3. Second law of thermodynamic,
4. The concept of vapor/liquid equilibrium,
5. The concept of chemical equilibrium.

**BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS**

Basic concepts: work, energy, heat, internal energy, extensive and intensive properties, state and path functions, First law of thermodynamics, energy balance for closed systems, equilibrium, the reversible process, constant-v and constant-p processes, enthalpy, heat capacity, energy balances for steady-state flow processes.

**VOLUMETRIC PROPERTIES OF PURE FLUIDS**

PVT behavior of pure substances, virial equations of state, the ideal gas, equations for process calculations(for an ideal gas in any mechanically reversible closed-system process): isothermal process, isobaric process, isochoric process, adiabatic process, and polytropic process. Application of the virial equations, introduction to cubic equations of state: van der Waals equation, Redlich/Kwong equation, theorem of corresponding states; acentric factor.

**SECOND LAW OF THERMODYNAMICS**

Statements, heat engines, Carnot's theorem, ideal-gas temperature scale; Carnot's equations, concept of entropy, entropy changes of an ideal gas undergoing a mechanically reversible process in a closed system, mathematical statement of the second law, entropy balance for open systems, statement of the third law of thermodynamics.

**INTRODUCTION TO VAPOR/LIQUID EQUILIBRIUM**

The nature of equilibrium, phase rule: Duhem's theorem, Pxy and Txy diagrams, simple models for VLE, Raoult's law, Dewpoint and bubblepoint calculations with Raoult's law for binary mixtures, Henry's law, VLE by modified Raoult's law, VLE from K-value correlations, flash calculations.

**CHEMICAL REACTION EQUILIBRIA**

Reaction coordinate, application of equilibrium criteria to chemical reactions, standard Gibbs-energy change and the equilibrium constant, effect of temperature on the equilibrium constant, evaluation of equilibrium

constants. Relation of equilibrium constants to composition: gas-phase reactions, liquid-phase reactions, equilibrium conversions for single reactions: single- phase reactions.

**TEXT BOOK**

1. Smith, J.M., Van Ness, H.C., and Abbott, M.M., "*Introduction to Chemical Engineering Thermodynamics*", 6th Edn., McGraw Hill International Edition, Singapore 2001.

**REFERENCE BOOKS**

1. Stanley I. Sandler, "*Chemical and Engineering Thermodynamics*", 2nd Edn., John Wiley & Sons, USA, 1989.
2. Rao Y.V.C, "Chemical Engineering Thermodynamics", University Press (I) Ltd., Hyderabad, 1997.
3. B.G. Kyle, "*Chemical Process Thermodynamics*", 2nd Edn., Prentice Hall of India Pvt.Ltd., New Delhi, 2000.

| **MA0244** | **BIOSTATISTICS** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **1** | **0** | **4** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course helps the students to obtain a proficiency in applying biostatistics principles in the field of biotechnology.

**INSTRUCTIONAL OBJECTIVES**

To familiarize:

1. Basic concepts of biostatistics
2. To expose to the probability and theoretica distributions
3. To expose them to the variance
4. To expose them to statistical quality control

**INTRODUCTION TO BIO-STATISTICS (numerical problems only)**

Handling univariate and bivariate data – Measures of central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression .

**PROBABILITY & THEORETICAL DISTRIBUTIONS**

Probability concepts – conditional probability – Baye's theorem – one – dimensional random variables – expectation, variance, moments.

Theoretical distributions : Binomial, Poisson, Normal (Problems only).

**TESTING OF HYPOTHESIS**

Introduction – Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportion, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, independence of attributes.

**ANALYSIS OF VARIANCE**

Small sample tests based on t and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances. ANOVA– one –way classification, Two-way classification.

**STATISTICAL QUALITY CONTROL**

Introduction – Process control – control charts for variables - $\overline{X}$ and R, $\overline{X}$ and s charts control charts for attributes : p chart, np chart, c chart.

**TEXT BOOKS**

1. S.C.Gupta & V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi , 2003.
   (**Unit -1** Chapter 2 Section 2.1, 2.3 – 2.9, Chapter 3 Section 3.1 – 3.7,3.8.1, 3.9, 3.13, 3.14, Chapter 10 Section 10.1-10.3,10.3.1,10.6, 10.7.1, 10.7.3-10.7.5, **Unit –II** Chapter 4 Section 4.1- 4.8, Chapter 5 Section 5.1-5.4, Chapter 6 Section 6.1-6.4, Chapter 7 Section 7.1-7.61, Chapter 8 Section 8.2 **UNIT III** Chapter 12

Section 12.4- 12.15, Chapter 13 Section 13.5, 13.7.2, 13.7.3 **UNIT IV** Chapter 14 Section 14.2, 14.2.8-14.5.5, Chapter 5 Section 5.1-5.3)

2. S.C.Gupta & V.K.Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi , 2003. (**UNIT V** Chapter 1 Section 1.10, 1.0-1.7.3.)

**REFERENCE BOOK**

1. W.Ewans & G.Grant, *Statistical Methods in Bio informatics* – An Introduction.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0202** | **GERMAN LANGUAGE PHASE - II** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **GERMAN LANGUAGE PHASE - I** | | | | |

**PURPOSE**

Enabling the Engineering Students to one more Foreign Language, especially German, which is scientific and technical language. This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites.

**INSTRUCTIONAL OBJECTIVES**

Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own C V and developing a fundamental conversation with any German national.

**SPEAKING;**

Dialogue – Questioning / Basic queries / Conversational with practical exposure.

**GRAMMATIK (WRITING)**

Verben, Wortstellung, Nomen, Pronomen, Artikel, Nominitativ, Akkusativ, Dativ, Adjective, Prasens, Perfect and Neben Satze.

**GLOSSARY**

Technical words. Lesson (6-10)

**TEXT BOOK WITH CASSETTES**

A. Grundkurs Deutsch
B. Momentmal

(Prescribed by Max Mueller Bhavan – Goethe Institute, Germany).

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0204** | **JAPANESE LANGUAGE PHASE II** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **JAPANESE LANGUAGE PHASE I** | | | | |

**PURPOSE**

1. In view of globalization, learning Foreign Language by Engineering graduates enhances their employment opportunities.
2. Get awareness of understanding of International culture.
3. Widening the Linguistic Skills of the Students.

**INSTRUCTIONAL OBJECTIVES**

To learn the scripts of Japanese Languages namely Hiragana, Katakana and Kanji, Vocabularies etc. To learn basic grammar and acquire basic communication skills. To understand Japanese culture.

Lesson 2-{Korewa Tsukue desu } – Grammar, Sentence pattern, Marume .
Conversation

Lesson 3 – [Kokoni denwa ga arimasu] - Grammar, Sentence pattern, Marume .Copnversation

Lesson 4– {Asokoni hito ga imasu} - Grammar, Sentence pattern, Marume .
Lesson 5– {Akairingo wa ikutsu arimasu ka}-Grammar, Sentence pattern, Marume . Conversation.
Lesson 6– {Barano hana wa ippon ikura desu ka}- Grammar, Sentence pattern.Marume.Conversation

**TEXT BOOKS**

1. Nihongo Shoho Imain Text sold in India by the Japanese Language Teachers Association Pune.
2. Hiragana and Katakana Work Book published by AOTS Japan
3. Grammar and Kotoba ( Work Book )
4. Japanese for Dummies.(Conversation) CD.

**SCHEME OF EVALUATION**

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

| | | L | T | P | C |
|---|---|---|---|---|---|
| **LE0206** | **FRENCH LANGUAGE PHASE II** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **FRENCH LANGUAGE PHASE I** | | | | |

**PURPOSE**

1. As language skills are as valuable as technical skills a knowledge of French enables the engineering graduates in career orientation.
2. As a second international global Lang after English there is a wider choice of job opportunities in the inter national employment market and also multinationals in India and an understanding of French culture thro language.

**INSTRUCTIONAL OBJECTIVE**

Characterised by the Roman script, grammar, vocabulary and colloquial expressions are taught which enables them to communicate effectively with any native speaker.

Sports (Ski, natation, tennis, Tour de France), Cuisine (French dishes),Cinema
(Review of a film) – Articles on these topics and group discussion will be followed.

**GRAMMAR**

Possessive Adjectives, Demonstrative Adjectives, Past tense – Passé Compose( Verbe Auxiliare:.Etre et Avoir)

Culture and Civilization French Monuments (Tres celebres), French History (Jeanne d' Arc, Louis XIV, Prise de la Bastille), Culture and Civilisation (vin, fromage, mode, parfums)

Transport system, government and media in France – articles on these topics.

Comprehension and Grammar Comprehension passages and conversational sentences in different situations (at the restaurant, at the super market)

**TEXT BOOK:**

1. Panorama – Goyal Publishers
2. Apprenons le Francais II, Sarawathy Publications

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0208** | **COMPREHENSION-I** | **0** | **2** | **0** | **1** |
| | **Prerequisite** | | | | |
| | Should have studied the Biotechnology related courses prescribed / opted for upto IV SEMESTER | | | | |

**PURPOSE**

To provide a compete picture of Biotechnology topics covered in I to IV semesters so that a comprehensive understanding of Biotechnology is achieved so that students are well prepared to face job interviews and subjects related competitive examinations.

**INSTRUCTIONAL OBJECTIVES**

1. To provide overview of all Biotechnology topics covered I to IV semesters.
2. To assess the overall knowledge level of Biotechnology standards and guide them to take corrective measures where deficiencies are detected.

**(Evaluation shall consist of a 3 hour duration end semester examination consisting of objective type and or conventional questions )**

**Total : 30**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0210** | **MOLECULAR BIOLOGY LABORATORY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner .

**INSTRUCTIONAL OBJECTIVES**

The students should be able to develop their skills in the

1. Isolation of plasmid DNA, genomic DNA and RNA
2. Electrophoresis and restriction digestion of DNA
3. Phage titration

**LIST OF EXPERIMENTS**

1. Preparation of Agarose Gel
2. Isolation of Plasmids
3. Isolation of Genomic DNA from blood, plant cell and bacteria
4. Isolation of RNA
5. Formaldehyde gel electrophoresis of RNA
6. Polyacrylamide gel electrophoresis of DNA
7. Restriction digestion of DNA
8. Ligation of digested of DNA
9. UV mutation
10. Phage Titration

**REFERENCE BOOK**

Sambrook *et al*, "*Molecular Cloning-A laboratory Manual*"

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0212** | **GENETICS LABORATORY** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **BT0203 GENETICS AND CYTOGENETICS** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner .

**INSTRUCTIONAL OBJECTIVES**

To impart knowledge about practical importance of Cell biology and genetics that was taught in the earlier semesters.

**LIST OF EXPERIMENTS**

1.Culturing of leukocytes
2. Determination of Mitotid Index
3. Preparation of chromosome spreads
4. Preparation of Karyogram
5. Identification of Chromosomal disorders
6. Study of polytene chromosomes of Diptera
7. Barr body preparation and staining
8. Analysis of Sister chromatid exchange

9. Extraction of Chromatin
10. Extraction and Electrophoresis of Histones

**REFERENCE BOOK**
*Laboratory manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD 0202** | **PERSONALITY DEVELOPMENT - IV** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**
1. To guide thought process,
2. To groom students' attitude,
3. To develop communication skill,
4. To build confidence.

**METHODOLOGY**
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Motivation II - Interpretation of Visuals of I & II

Humor in real life - Body language - Collage and poster designing and slogan writing

Brain Teasers – JAM - Current News Update I

Current News Update II - Enactment (SKIT –I) - Enactment (SKIT – II)

Survey and Reporting (heroes, sports persons etc.) - Quiz III – Review

**EVALUATION:**
1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

**SCHEME OF INSTRUCTION**
Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**
Complete Internal evaluation on a regular Basis

## SEMESTER V

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0301** | **VECTOR BIOLOGY AND GENE MANIPULATION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The subject deals with different cloning vectors in eukaryotes and prokaryotes and different expression vectors and applications of cloning and expression vectors. The subject also deals with different strategies of gene cloning and construction of genomic and cDNA library and applications of recombinant DNA technology

**INSTRUCTIONAL OBJECTIVES**

1. To strengthen the knowledge on various cloning and expression vectors
2. To impart the importance of vectors in genetic engineering experiments
3. To strengthen the knowledge on various strategies of gene cloning
4. To impart the importance of genetic engineering

**INTRODUCTION TO CLONING**

Overview of Cloning, Purification and Separation of Nucleic Acids – cutting and joining DNA and vectors. Plasmid vectors, phage vectors,cosmids , YAC and expression vectors

**GENOMIC AND cDNA LIBRARIES**

Genomic libraries – cDNA libraries – Screening libraries –PCR.

**DNA SEQUENCING**

Principles of DNA Sequencing – Analysis of sequence data, Analysis of genetic variations.

**ANALYSIS AND MANIPULATION OF GENE EXPRESSION AND FUNCTION**

Analysis of gene expression – analyzing transcription and translation, Analysis of gene function – Genetic maps – linkage analysis – transposon mutagenesis – Manipulation of gene expression – Expression in Bacteria and Eukaryote host cells – in vitro mutagenesis.

**APPLICATIONS OF CLONING**

Medical applications – vaccines – human and genetic diseases – transgenics.

**TEXTBOOKS:**


1. *From Genes to Genomes* by Jeremy W. Dale and Malcolm von Schantz, 2002, John Willey and sons Publications - 353 pages.
2. *Principles of Gene Manipulation, An Introduction to Genetic Engineering* Old R.W.Primrose SB, - Blackwell Scientific Publications


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0303** | **ANIMAL BIOTECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course deals with the Animal cell culture, Embryo transfer, Recombinant vaccines, Manipulation of growth of animals, lactation, meat and milk production

**INSTRUCTIONAL OBJECTIVES**

1. To impart knowledge on production of transgenic animals and how to improve the meat and milk production
2. To make the students to understand the concepts and applications

**ANIMAL BREEDS**

Breed-Species-different types of breeding, upgrading, Economic traits-Quantitative trait loci- Marker assisted selection-Genetic disorders-Chromosomal aberrations in farm animals.

**EMBRYO TRANSFER AND TRANSGENIC ANIMALS**
Artificial insemination, Superovulation, Embryo transfer, In vitro fertilization-Pregnancy diagnosis-Sexing of embryos, Embryo splitting; Cryopreservation of embryo; Transgenic animlas-Transgenic fish; Animal as bioreactors.

**ANIMAL CELL CULTURE**
Principles of sterile techniques and cell propagation-Chemically defined and serum free media for cell culture; Scaling up of animal cell cultures; Preservation and characterization of animal cells, organ culture; Cytotoxicity and viability assays; Cell culture as source of valuable products-Protein production by genetically engineered mammalian cell lines, Stem cells and their applications.

**RECOMBINANT VACCINES FOR ANIMAL HEALTH**
Common viral, bacterial and parasitic diseases affecting animals-Live vaccines, killed vaccines-Subunit vaccines-Recombinant vaccines-DNA vaccines

**BIOTECHNOLOGY IN ANIMAL PRODUCTION**
Manipulation of Growth hormone -somatotropic hormone-Thyroid hormone; Probiotics as growth promoters-Ideal characteristics of probiotics, Mode of action-uses of probiotics-Manipulation of lactation -Lactogenesis-galactopoiesis-Manipulation of wool growth-Manipulation of rumen microbial digestive system.

**TEXT BOOKS**
1. *Animal cell culture* by R.I. Freshney
2. *Animal Biotechnology* by P.Ramadas
3. *In vitro cultivation of Animal cells* by Dr.C.K.Leach,Butterworth and Heinnmamm Ltd.1994.
4. *Hand book of Animal Husbandry* by Gopalakrishnan .

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0305** | **ANALYTICAL TECHNIQUES** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **BT0102 BIOCHEMISTRY, BT0206 BIOPHYSICS** | | | | |

**PURPOSE:**
The subject is taught to give a comprehensive understanding of the various techniques used in the analysis of compounds and drugs by different branches of biotechnology. The student will gain thorough information on the principles of the techniques

**INSTRUCTIONAL OBJECTIVES:**
1. To impart knowledge about the theoretical working of spectrometry and chromatography
2. To teach the application of such techniques in biotechnology and related fields

**SPECTROSCOPY 1**
Introduction to absorption and emission spectroscopy – UV and visible spectrometers UV visible and absorption method, fluorescence and phosphorescence spectrophotometry

**SPECTROSCOPY 2**
Infrared spectrometers, X ray methods, NMR spectroscopy and spectrometry.

**NMR AND MASS SPECTROMETRY**
NMR – basic principles –types-spectra and molecular structure-elucidation, quantitative analysis and integration and applications in medicine –mass spectrometry.

**CHROMATOGRAPHY**
Chromatography – general principles – gas chromatography – detectors –optimization, gas solid chromatography columns –interfiling with main spectroscopy and infrared spectrometry.

**HPLC**
HPLC theory and instrumentation – HPLC methods and applications.

**TEXT BOOKS**
*Instrumental methods of analysis* by Willard, Merit Dean and Settle Edition 1986. CBS publishers and distributors.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0307** | **PLANT BIOTECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course deals with the DNA isolation and transfer to plants and animals and production of transgenic animals and plants

**INSTRUCTIONAL OBJECTIVES**

1. To impart knowledge on production of transgenic plants
2. To make the students to understand the concepts and applications

**PLANT GENOMES AND PLANT TISSUE CULTURE**

Introduction-gene structure and gene expression-regulation, implication for plant transformation,-Protein targeting, heterologous promoters, genome size and organization, Arabidopsis and new technologies. Plant tissue culture-plasticity and totipotency, culture environment, growth regulators, media regulators, culture types, plant regeneration.

**PLANT TRANSFORMATION TECHNIQUES**

Introduction- *Agrobacterium* mediated gene transfer –Ti-plasmid-process of T-DNA transfer and integration, transformation in plant, Direct gene transfer methods. Binary vectors- basic features of vectors-optimization-clean gene technology.

**TRANSGENIC PLANTS-HERBICIDE AND PEST RESISTANCE**

Herbicide resistance-use of herbicide in modern agriculture-strategies for engineering herbicide-Resistance-environmental impact, pest resistance-nature and scale of insect / pest damage to crop-GM strategies-Bt approach to insect resistance-copy nature strategy-insect resistant crops and food safety.

**PLANT DISEASE RESISTANCE AND STRESS TOLERANCE**

Introduction-plant-pathogen interactions-natural disease resistance pathways-biotechnological -Approaches to disease resistance. Plant viruses- types-entry and replication-transgenic approach-PDR Stress tolerance-abiotic stress-water deficit stress and various approaches for tolerance.

**MOLECULAR FARMING AND GM CROPS FUTURE PROSPECTS**

Introduction-carbohydrates and lipids production-molecular farming of proteins-economic considerations for molecular farming.GM crops-current status-concerns about GM crops- regulations of GM crops and products-Greener genetic engineering.

**TEXT BOOK**

*Plant Biotechnology-The genetic manipulation of plants.* Adrian Slater, NigelW.Scott and MarkR.Fowler.Oxford university press, pg-341.

| **CH0319** | **MASS TRANSFER** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course explains the fundamentals of mass transfer operations and techniques involved in drying, distillation, leaching, extraction, adsorption, crystallization, membrane separation and ion-exchange processes.

**INSTRUCTIONAL OBJECTIVES**

To familiarize:

1. Diffusion phenomena of mass transfer operations.
2. Drying & distillation operations.
3. Leaching and extraction processes.
4. Adsorption & crystallization operations.

5. Processes such as membrane separation, electro dialysis, thermal & sweep diffusion, ion exchange.

**DIFFUSION**
Molecular diffusion, steady state molecular diffusion in fluids at rest and in laminar flow, molecular diffusion in gases-steady state diffusion: of A through nondiffusing B, equimolal counter diffusion, in multicomponent mixtures. Molecular diffusion in liquids-steady state diffusion: of A through nondiffusing B, equimolal counter diffusion. Effect of temperature and pressure on diffusivity.

**DRYING & DISTILLATION**
Importance of drying in processes, principles of drying, equilibrium and free moisture, bound and unbound water, constant drying conditions, constant-rate period, critical moisture content and falling-rate period, porous solids and flow by capillarity, calculation of drying time under constant drying conditions.-Classification of dryers, solids handling in dryers, equipments for batch and continuous drying processes: working principle of tray driers, tower driers, rotary driers, spray driers. Concept of freeze drying. -Basic concepts of various methods of distillation: batch, continuous, flash, steam, azeotropic and vacuum distillations.

**LEACHING AND EXTRACTION**
General principles of leaching, working principle of moving-bed leaching equipments: Bollman extractor, Hildebrandt extractor. General principles of extraction, working principle of extraction equipments: mixer-settlers, spray and packed extraction towers, agitated tower extractors. Percentage extraction calculation for single stage and multistage crosscurrent operations when liquids are insoluble. Minimum solvent rate and number of theoretical stages for continuous countercurrent, multistage extraction operation when liquids are insoluble.

**ADSORPTION & CRYSTALLIZATION**
Introduction to adsorption, adsorbents and adsorption processes, adsorption equipment: fixed-bed adsorbers, gas-drying equipment. Pressure-swing adsorption, adsorption from liquids, adsorption isotherms.-Introduction to crystallization, Mier's supersaturation theory, crystallization equipment: continuous vacuum crystallizer, Draft tube-baffle crystallizer (with and without internal system for fines separation and removal), Swenson-walker crystallizer. Material and energy balance calculations in batch crystallizers.

**MISCELLANEOUS PROCESSES**
Membrane separation process-types of membranes-concepts of osmosis, electro dialysis, their application-elementary concept of thermal diffusion, sweep diffusion, foam separation process.-Ion-exchange-principles and industrial application of Ion exchange, types of ion exchange resins.

**TEXT BOOKS**

1. Warren L. Mccabe, Julian C. Smith and peter Harriott, "*Unit Operations of Chemical Engineering*", 6th Edn., McGraw Hill International Edition, New York 2001.
2. Robert E. Treybal, "*Mass-Transfer Operations*", 3rd Edn., McGraw Hill International Ed., Singapore, 1980.


**REFERENCE BOOK**

1. Coulson J.M., J.F. Richardson, J.R. Backhurst and J.M. Harker, "***Coulson & Richardson's Chemical Engineering***", Vol. I, 6th Edn., Butter worth Heinemann, Oxford, 1999.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0309** | **BIOPROCESS ENGINEERING LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **BIOPROCESS PRINCIPLES** | | | | |

**PURPOSE**
Enables the student to develop their skills in the field of enzyme isolation its assay, enzyme kinetics and microbial fermentation.

**INSTRUCTIONAL OBJECTIVES**
The students will be able to
1. Develop their practical skills in enzyme isolation and purification.
2. Evaluate enzyme kinetics
3. Carry out enzyme immobilized reaction and microbial culture
4. Develop practical skill in submerged and solid state fermentation.

**LIST OF EXPERIMENTS**

1 Isolation of proteolytic organism from soil sample
2 Glucose assay by DNS method
3 Evaluations of enzyme kinetic parameters
4 Enzyme activity calculation
5 Determination of optimum pH for enzyme
6 Determination of optimum temperature for an enzyme
7 Enzyme immobilized by alginate gel method
8 Hydrolysis of starch by immobilized method
9 Effect of substrate concentration on biomass yield
10 Solvent extraction techniques for product recovery

**REFERENCE BOOK:**

*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0317** | **INDUSTRIAL TRAINING*** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0311** | **GENE MANIPULATION LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **BT0203 GENETICS AND CYTOGENETICS** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts of genetic engineering already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTIONAL OBJECTIVES**

The student will be able to understand and develop the concept of recombinant DNA technique.

**LIST OF EXPERIMENTS**

1. Isolation and Restriction enzyme digestion of bacterial genomic DNA
2. Purification of digested DNA-column purification
3. Preparation of target DNA by linker/adapters/alkaline phosphatase treatment for cloning
4. Ligation of DNA fragment with cloning vector
5. Preparation of competent cells
6. Transformation in *E.coli* with recombinant vector
7. Isolation of recombinants and confirmation of insert DNA in vector
8. Preparation of DNA probe by nick translation /PCR
9. Southern Hybridisation
11. DNA Finger printing

**REFERENCE BOOK:**

Sambrook et al " *Molecular Cloning*" A Laboratory manual

| **CH 0331** | **MASS TRANSFER LABORATORY** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **4** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course helps the students to experimentally verify the theoretical concepts they learnt in the course: CH 319 Mass Transfer.

**INSTRUCTIONAL OBJECTIVES**

To make the students to experimentally

1. Determine the percentage extraction .
2. Determine overall stage efficiency of a continuous counter current leaching unit.
3. Verify the applicability of Freundlich equation for adsorption of acetic acid on activated carbon.
4. Verify Rayleigh's equation.

**LIST OF EXPERIMENTS**

1. Simple distillation
2. Steam distillation
3. Leaching
4. Batch adsorption
5. Diffusion
6. Air drying
7. Continuous absorption
8. Extraction
9. Vacuum drying
10. Infra red drying

**REFERENCE**

*Laboratory manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD 0301** | **PERSONALITY DEVELOPMENT - V** | **1** | **0** | **2** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**

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

1. Acquire the important soft skills for employment
2. Take part in group discussions and job interviews confidently
3. Appear for placement aptitude tests confidently
4. Gain self confidence to face the placement process

**METHODOLOGY**

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Syllogism - Binary Logic [cause & effect] - Assertive & Counter Argument - Simple Interest - Time & Work - Time & Distance

Upstream & Downstream Reasoning - Verbal Comprehension I - Verbal Comprehension II- Compound Interest- Logarithms - Surds & Indices

Verbal Reasoning I - Verbal Reasoning II - Verbal Reasoning III – Percentage – Test – Averages

Deductive Reasoning I - Deductive Reasoning II - Language Usage I - Decimal Fractions - Profit & Loss – Probability

Language Usage II - Logic Games I - Logic Games II – Area - Pipes & Cisterns – Test

**SCHEME OF INSTRUCTION**
Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**
Complete Internal evaluation on a regular Basis

**SEMESTER VI**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0302** | **GENOMICS AND PROTEOMICS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course offers advanced level training on gene expression and gene therapy by covering topics such as genome mapping, proteomic techniques and new targets for drug discovery.

**INSTRUCTIONAL OBJECTIVES**
To familiarize and expose the students to the
1. Principle of gene expression
2. Concepts of functional genomics in biopharmaceutical industry
3. Application of gene therapy
4. Principles of proteomics
5. Role of models in genetic disorder

**INTRODUCTION TO GENOMICS**
New science of genomics, orientation and structure of genomes, subdividing the genome, assembling a physical map of a genome.

**COMPARATIVE AND STRUCTURAL GENOMICS**
Sequencing methods and strategies, genome annotation and bioinformatics, comparative Genomics, protein structural genomics.

**MAPPING PROTEIN INTERACTION AND APPLICATIONS**
Global expression profiling, comprehensive mutant libraries, mapping protein interactions, applications of genome analysis and genomes.

**INTRODUCTION AND TOOLS OF PROTEOMICS**
Proteomics and Proteomes, Various tools used in proteomics.

**APPLICATIONS OF PROTEOMICS**
Mining proteomes, protein expression profiling, identifying protein – protein Interactions and protein complexes, mapping- protein identification, new directions in proteomics**.**

**TEXT BOOK:**
*Introduction to Proteomics* by Daniel. C. Liebler, Humana press, 2002,198 pages.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0304** | **PROTEIN ENGINEERING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The course imparts advanced knowledge on proteins through a detailed study of protein structure, its characteristics property and significance in biological systems .

**INSTRUCTIONAL OBJECTIVES**

1. To focus and acquire advanced knowledge on structures of proteins.
2. Protein design principles and database analysis.

**INTRODUCTION TO PROTEIN ENGINEERING**

Primary structure, secondary structure, tertiary structure, quaternary structure, Ramachandran plots.

**PROTEIN STRUCTURE PREDICTION**

Strategies for design of novel proteins-strategies for the design of structure and function, computer methods in protein modeling

**PRODUCTION OF NOVEL PROTEINS**

Site and strategies for heterologous expressions, methods for expressing recombinant proteins in yeast, in vitro mutagenesis.

**CHARACTERIZATION OF PROTEINS**

NMR spectroscopy, crystallography, spectroscopic and calorimetric methods.

**APPLICATIONS OF PROTEIN ENGINEERING**

Design of polymeric biomaterials, nicotinic acetylcholine receptors as a model for a super family of ligand - gated ion channel proteins

**TEXT BOOK:**

*Protein engineering and design* by Paul R. Carey, academic press, 1996, 361 pages.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0306** | **BIOPROCESS ENGINEERING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **BT0204 BIOPROCESS PRINCIPLES** | | | | |

**PURPOSE**

This subject deals with the design, analysis monitoring modelling and simulation aspect of bio reactors

**INSTRUCTIONAL OBJECTIVES**

1. To strengthen the knowledge on design operation and stability analysis of bioreactors
2. Bioreactor scale up
3. Methods of on line and off line monitoring of bio process
4. Modern bio technological process
5. Fundamentals of modelling and simulations of bio process.

**DESIGN AND ANALYSIS OF BIOREACTORS**

Modelling of Non-ideal Behaviour in Bioreactors-Tanks-in-series and Dispersion models-applications to design of continuous sterilizers; Design and operation of novel bioreactors-Air-lift loop reactors; Fluidized bed-bioreactors; Stability analysis of bioreactors.

**BIOREACTOR SCALE-UP**

Transport phenomena in Bioprocess systems, Regime analysis of bioreactor processes, Correlations for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption.

**MONITORING OF BIOPROCESSES**
On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes; computers and interfaces, Computer-based data acquisition, monitoring and control-LABVIEW Software.

**MODERN BIOTECHNOLOGICAL PROCESSES**
Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modelling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures.

**MODELLING AND SIMULATION OF BIOPROCESSES**
Study of Structured Models for analysis of various bioprocesses; Model simulation using MATLAB-SIMULINK and ISIM software packages.

**TEXT BOOKS**

1. Alba S., Humphrey E and Milli N.R., "*Bio Chemical Engineering*" Academic Press, 1973.
2. Scragg.A.H "*Bioreactors in Biotechnology*"- A Practical approach
3. Bailey and Ollis, "*Biochemical Engineering Fundamentals*", McGraw Hill (2nd Ed.). 1986.
4. Peter F.Stanbury, Allan Whitaker, "*Principles of Fermentation Technology*"


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0308** | **BIOINFORMATICS** | **2** | **0** | **1** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Aims at providing an elementary knowledge of bio informatics and its application

**INSTRUCTIONAL OBJECTIVE**
1. Scope of Bioinformatics
2. Introduction to sequence alignment and programming
3. Database and their use
4. Protein analysis using bio informatics tools
5. DNA mapping and other special topics in bio informatics
6. Introduction to PERL

**INTRODUCTION AND NCBI**
Internet basics; Connecting to internet; Email; FTP; www; The NCBI data model: Introduction, BIOSEQ's, BIOSEQ- sets, SEQ- ANNOT, SEQ- DESCR.

**BIOLOGICAL DATABASES**
Biological databases-primary sequence databases- Composite sequence databases- Secondary databases-composite protein pattern databases-structure classification databases. Genome Information Resources: DNA sequence databases-specialized genomic resources, GRAIL, GENSCAN

**ALIGNMENT TECHNIQUES**
Pairwise Alignment Technique: Database searching-algorithms and programs-comparing two sequences-identity and similarity-global and local alignment- pairwise database searching. Multiple sequence Alignment: Goal of multiple sequence alignment-Computational Complexity-Manual methods-Simultaneous methods-Progressive methods-Databases of multiple alignment-Secondary database searching-Analysis packages.

**PROTEIN ANALYSIS**
Protein identity based on composition, Motifs and patterns, secondary structure prediction, specialized secondary structures, tertiary structure

**INTRODUCTION TO PERL**
Using PERL to facilitate biological analysis-Strings, numbers, variables-Basic input & output- File handles-Conditional Blocks & loops- Pattern matching- Arrays-Hashes.

**LIST OF EXPERIMENTS**

1. Knowledge about nucleotide Databases.
2. Knowledge about Protein databases.
3. Literature survey through Pubmed.
4. Local similarity search.
5. Global similarity search.
6. Gene prediction and translation.
7. Protein sequence analysis.

**TEXT BOOKS**


1. Andreas D Baxevanis & B F Francis," *Bioinformatics- A practical guide to analysis of Genes & Proteins*", John Wiley, 2002.
2. T K Attwood, D J Parry-Smith," *Introduction to Bioinformatics*", Pearson Education, 1st Edition, 11th Reprint 2005.


**REFERENCE BOOKS**


1. C S V Murthy,"*Bioinformatics*", Himalaya Publishing House, 1st Edition 2003.
2. S.C.Rastogi & others, " *Bioinformatics- Concepts, Skills, and Applications*", CBS Publishing, 2003.
3. Michael R Barnes & Ian C Gray, " *Bioinformatics for Geneticists*", John Wiley, 2003.


| CH0318 | INSTRUMENTATION AND PROCESS CONTROL | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course will make the students knowledgeable in various types of measuring instruments used in chemical process industries.

**INSTRUCTIONAL OBJECTIVES**

To familiarize :

1. Temperature measurement devices.
2. Various methods of composition analysis.
3. Basic concepts of process control.
4. Linear closed loop systems.
5. Control schemes and micro processor.

**TEMPERATURE MEASUREMENTS**

Thermoelectric temperature measurement: thermoelectricity, industrial thermocouples, thermocouple lead wires, thermal wells, industrial potentiometers. Resistance thermometers: thermal coefficient of resistance, industrial-resistance-thermometer bulbs, null-bridge resistance thermometers, deflect ional resistance thermometer. Radiation temperature measurement: radiation receiving elements, radiation pyrometers, photoelectric pyrometers, optical pyrometers.

**COMPOSITION ANALYSIS**

Spectroscopic analysis, adsorption spectroscopy, emission spectroscopy, mass spectroscopy. Analysis of solids by X-ray diffraction, color measurement by spectrometers, gas analysis by thermal conductivity, psychomotor method for moisture in gases, hygrometer method for moisture in gases, dew-point method, measurement of moisture in paper, textiles and lumber, pH ion concentration measurement.

**BASIC CONCEPTS OF PROCESS CONTROL**

Laplace transform of simple functions, transforms of derivatives, solution of differential equations, inversion by partial fractions: partial fractions. Response of first-order systems, physical examples of first-order systems, response of first-order systems in series, higher order systems: second-order, and transportation lag.

**LINEAR CLOSED LOOP SYSTEMS**

Control system, controllers and final control elements, block diagram of a chemical reactor control system, closed-loop transfer functions, transient response of simple control systems, Root locus.

**CONTROL SCHEMES AND MICRO PROCESSOR**

Control schemes for heat exchangers and chemical reactors. Control of distillation column: control of composition, feed rate, pressure and feed temperature.-Microprocessor-based controllers: hardware components, tasks of microprocessor-based controller, implementation of control algorithms.

**TEXT BOOKS**


1. Donald P. Eckman, "*Industrial Instrumentation*", Wiley Eastern Limited, 1993.
2. Coughanour D.R., "*Process system Analysis & Control*", 2nd Edn., McGraw Hill, Singapore, 1991.
3. Peter Harriott, "*Process Control*" McGraw Hill, New York, 1972.


**REFERENCE BOOKS**


1. Sharma B.K., "*Instrumental Methods of Chemical Analysis*", 7th Edn., Goel Publishing, Meerut, 1985-86.
2. Galen W. Ewing, "*Instrumental Methods of Chemical Analysis*", 5th Edn., McGraw Hill, New York, 1985.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0310** | **PLANT CELL &TISSUE CULTURE LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **BT0307 PLANT BIOTECHNOLOGY** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTONAL OBJECTIVES**

The students should be able to

1. Understand explicitly the concepts
2. Develop their skills in the plant tissue culture techniques

**LIST OF EXPERIMENTS**

1. Organizing Plant tissue culture Laboratory
2. Preparation of Tissue Culture Media
3. Callus Induction
4. Shoot tip culture
5. Embryo / Endosperm Culture
6. Somatic Embryogenesis
7. Hardening and Planting infield
8. Isolation of protoplasts
9. Cell suspension culture
10. Economics of micropropagation project

**REFERENCE BOOK**

*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0312** | **ANIMAL CELL CULTURE LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **BT0303 ANIMAL BIOTECHNOLGY** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTONAL OBJECTIVES**

The students should be able to

1. Understand explicitly the concepts
2. Develop their skills in the animal cell culture techniques

**LIST OF EXPERIMENTS**

1. Preparation of culture media and sterilization
2. Organ culture, Fibroblast culture.
3. Adaptation of Animal virus in cell lines BHK-21-vero cell line.
4. Study of effect of anti cancer agent in cell culture.
5. MTT Assay
6. Live cell counting
7. Leukocyte culture
8. Culturing of spleen cells
9. Myeloma cell culture
10. Fusion of cells by PEG

**REFERENCE BOOK**

*Laboratory Manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0314** | **FERMENTATION LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTIONAL OBJECTIVES**

The students will be able

1. Develop the skills of large scale production of secondary metabolites.
2. Identify the growth factors
3. Study the batch and continuous culture growth
4. Evaluate the temperature effect on culture growth

**LIST OF EXPERIMENTS**

1. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for micro-organisms. Batch, fed batch and continuous cultures a) Estimation of Monod parameters b) Pure and mixed cultures.
2. Production of secondary metabolite by plant cells in a photobioreactor. Production of secondary metabolites in synthetic and complex industrial media.
3. Production of wine by yeast.
4. Production of Aminoacid.
5. Screening of process variables single dimensional search, Blackett Burman design, design expert etc.
6. Study of rheology of fermentation broth and power determination.

**REFERENCE BOOK**

*Laboratory manual*

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0316** | **COMPREHENSION-II** | **0** | **2** | **0** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

| | | L | T | P | C |
|---|---|---|---|---|---|
| **PD 0302** | **PERSONALITY DEVELOPMENT VI** | **1** | **0** | **2** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The purpose of this course is to build confidence and inculcate various soft skills and to help Students to identify and achieve their personal potential

**INSTRUCTIONAL OBJECTIVES**
At the end of the course the students will be able to
1. Acquire the important soft skills for employment
2. Take part in group discussions and job interviews confidently
3. Appear for placement aptitude tests confidently
4. Gain self confidence to face the placement process

**METHODOLOGY**
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.
1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Self Introduction - Narration - Current News Update – Numbers - Height & Distance - Square & Cube Roots

Current Tech Update - Verbal Aptitude Test I - GD –I - Odd man out series - Permutation & Combination - Problems on ages

GD –II - Resume Writing - Mock Interview I / reading comprehension - Problems on trains – Allegation of Mixtures - Test

Mock Interview II / reading comprehension - Mock Interview III/ reading comprehension - GD – III - Ratio & Proportion - Clocks - H.C.F & L.C.M

GD – IV - Verbal Aptitude Test II – Review – Partnership – Puzzles – Test

**SCHEME OF INSTRUCTION**
Marks allocated for regular participation in all oral activities in class

**SCHEME OF EXAMINATION**
Complete internal evaluation on a regular Basis

**SEMESTER VII**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0403** | **BIOREACTOR DESIGN** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **BT0306 BIOPROCESS ENGINEERING** | | | | |

**PURPOSE**
The course imparts advanced knowledge on bioreactor design for efficient utilization of the principles in bioprocess technology.

**INSTRUCTIONAL OBJECTIVES**
To familiarize:
1. Basic concepts of bioreactor design .
2. Bioreactor instrumentation and control
3. Methods and strategies for fermentation control
4. Modelling and simulation of fermentation processes
5. Plant and animal cell bioreactors

**BIOREACTOR DESIGN**
Types of Bioreactor, Heat transfer, Scale – up, Airlift Bioreactors, Introduction, Design and construction of the airlift – loop reactor, Hydrodynamics, Three – phase flow, Mixing, Oxygen transfer.

**BATCH AND CONTINUOUS GROWTH**
Growth, Measurement of microbial growth (direct), Measurement of microbial growth (indirect), Kinetics of cell growth in batch culture, Continuous culture.

**MIXING, MASS TRANSFER AND**
**INSTRUMENTATION CONTROL OF BIOREACTORS**
Introduction, Mass transfer, Theory of mixing, Rheological properties, Bioreactor sensor characterizes, Temperature measurement control, principles of dissolved oxygen measurement and control, principles of pH / redox measurement and control, deduction and prevention of foam, determination of biomass and application of biosensors.

**BIOREACTOR OFF – GAS ANALYSIS**
Introduction, generalized gas balance equations, Steady – state balancing, Derived quantities based on combined gas analysis and gas mass balancing techniques, Gas analysers.

**MODELING OF PLANT AND ANIMAL CELL BIOREACTORS**
Modelling, digital simulation, formulation and solution of problems by simulations, digital simulation programming languages, ISIM (interactive simulation language) Plant cells, Animal cells.

**TEXT BOOK:**
1. "*Bioreactors in Biotechnology*", Ellis Horwood series, 1991. A. H. SCRAGG.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0407** | **BIOSEPARATION TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **BT0306 BIOPROCESS ENGINEERING** | | | | |

**PURPOSE**
The course provides an opportunity to understand the importance of the Bioseparation process, economics and process design criteria for various classes of bio products.

**INSTRUCTIONAL OBJECTIVES**
1. To make the student understand the importance of Bioseparation processes
2. Cell disruption
3. Filtration, sedimentation and extraction
4. Product resolution
5. Product crystallization and drying and process economics

**INTRODUCTION TO BIOSEPARATION PROCESS**
Role and importance of Bioseparation process in biotechnological processes. Problems and requirements of bioproduct purification. Cost- cutting strategies Characteristics of biological mixtures – Process of Classification of Bioproducts -Biological activity, Analysis of purity-Process economics-Capital and operating cost analysis

**CELL DISRUPTION AND SEDIMENTATION**
Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods.

**FILTRATION, PRECIPITATION AND EXTRACTION**
Membrane based separations micro and ultra filtration theory, design and configuration of membrane separation equipment, applications, precipitation methods (with salts, organic solvents, and polymers, extractive separations, aqueous two-phase extraction, supercritical extraction), *in situ* product removal.

**CHROMATOGRAPHY AND ELECTROPHORESIS**
Adsorptive chromatographic separation processes, gel permeation chromatography, all electrophoresis techniques including capillary electrophoresis, hybrid separation technologies-membrane chromatography, electro chromatography. -HPLC

**PRODUCT CRYSTALLISATION AND DRYING**
Crystallisation.-Principles-Nucleation-Crystal growth-Kinetics-Batch crystallizers-Process crystallizers of proteins-Scale-up and design- Drying –Principles-Water in biological solids-Heat and mass transfer-Dryer description and operation-Vacuum shelf and rotary dryer-Freeze dryer-Spray dryer-Scale-up and design-spreadsheet and simulators.

**TEXT BOOKS**
Roger G Harrison et al "*Bioseparation Science and Engineering*" Oxford University Press, 2003
Belter PA and Cussler E, " *Bioseparations* ", Wiley 1985

**REFERENCE BOOKS**
1. Wankat P.C, " *Rate controlled separations* ", Elsevier, 1990
2.Asenjo J.M., " *Separation processes in Biotechnology* " Marcel Dekker Inc. 1993.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0411** | **FERMENTATION TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course is taught to give a basic understanding of the types of fermentation process, bioprocess, and the preparation of media, and anaerobic digesters.

**INSTRUCTIONAL OBJECTIVES**
1. To educate the students about microorganisms, development of media, and anaerobic digesters
2. To make the students understand the fermentation process using these tools and its combination of bioprocess engineering

**PILOT PLANT FERMENTATION**
Microbial fermentation, Mammalian cell culture system, Plant cell tissue and organ cultures.

**FERMENTATION DESIGN**
Fermentation department, equipment and space requirements, the design of large fermenters (based on aeration), Statistical Methods for Fermentation Optimization.

**ENVIRONMENTAL CONCERNS ABOUT FERMENTATION**
Environmental regulations and technology, laws and regulations, Technology (waste water), Waste water treatment strategy, Air (emissions of concerns), Selecting a Control Technology, Inorganics, and Volatile Organic Compound Emission Control.

**ANAEROBIC DIGESTERS**
An overview of aerobic and anaerobic fermentation. Substrates, Products and Biogas, Operational Conditions, Types of anaerobic digesters.

**BIOREACTOR FOR PLANT CELL CULTURE**
Biochemical Engineering of the Production of Plant – specific Secondary metabolites by Cell Suspension Cultures, Gas Concentration Effects on Secondary Metabolite Production by Plant Cell Cultures, Integrated Bioprocessing for Plant Cell Cultures and Large – Scale plant micro propagation.

**TEXT BOOKS:**
1. *Fermentation and biochemical engineering handbook* by Henry C. Ogal, 2nd edition, Noyes Publications, Pages 801.
2. *Advances in Biochemical Engineering Biotechnology* by T. Sceper and J.J Zhong; Springer Publication. Pages 218.
3. *The Microbiology of anaerobic digesters* by Michael H. Gerardi, A John Wiley & Sons, Inc., Publication, 2003, pages 177.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0413** | **BIOSEPARATION LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTIONAL OBJECTIVES**

The students will be able to get exposure on various Bioseparation process such as

1. Cell disruption techniques
2. Product enrichment techniques
3. Product purification methods

**LIST OF EXPERIMENTS**

1. Chemical cell disruption and assay for intracellular products
2. Mechanical cell disruption and assay for intracellular products
3. Separation of insolubles by filtration / sedimentation / centrifugation
4. Ammonium sulphate precipitation and dialysis
5. Gel analysis/ assay for dialysed product
6. Ion Exchange chromatography
7. Gel filtration
8. FPLC
9. HPLC
10. Gas chromatography

**REFERENCE BOOK:**

Scopes AK, " *Protein Purification* " , IRL Press, 1993.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0417** | **INDUSTRIAL TRAINING**** | **0** | **0** | **2** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **CH 0409** | **BIOPROCESS EQUIPMENT DESIGN AND DRAWING LABORATORY** | **L** | **T** | **P** | **C** |
| | | **0** | **0** | **4** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course makes the students to learn the methods and practice followed in the design of Bioprocess equipments. Also makes the students to draw the designed equipments to scale.

**INSTRUCTIONAL OBJECTIVES**

To familiarize:

1. The design methods and drawing of various types of vessels used in Bioprocess industries.
2. The design methods and drawing of different types of agitators used in Bioprocess equipments.
3. The design methods and drawing of different type of heat exchangers used in Bioprocess operation.
4. The design methods and drawing of dryers used in Bioprocess operation.
5. The design methods and drawing of crystallizers used in Bioprocess operation.

**VESSELS**

Detailed design and drawing of enclosures, supports and standard flanges, storage vessels including unfired pressure vessels, reaction vessels. - Fed batch Reactor, Chemostat, plug flow reactor

**AGITATORS**

Detailed design and drawing of various types of agitators used in Bioprocess equipments

**HEAT EXCHANGERS**

Detailed design and drawing of various types of heat exchangers. employed in Bioprocess operation.

**DRYERS**
Detailed design and drawing of dryers used in Bioprocess operation

**CRYSTALLIZERS**
Detailed design and drawing of crystallizers used in Bioprocess operation

**TEXT BOOK**
1. Sinnott, R.K., Coulson & Richardson's "*Chemical Engineering*", Volume 6, 3rd Edn., Butterworth Heinemann, New Delhi, 1999.

**REFERENCE BOOKS**
1. Perry, R.H., et al., Perry's "*Chemical Engineers Handbook*", 7th Edn., McGraw Hill, NewYork, 1997.
2. Joshi, M.V., and Mahajani, V.V., "*Process Equipment Design*", 3rd Edn., Macmillan India Limited, New Delhi, 1996.
3. Bownell, L.E., and Young, E.M., "*Process Equipment Design*", Wiley Eastern, 1968.

**SEMESTER VIII**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0402** | **BIOSAFETY, BIOETHICS, IPR &PATENTS** | **2** | **0** | **0** | **2** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course creates awareness on the Biosafety, bioethics, Intellectual property rights and patenting of bio-technological processes.

**INSTRUCTIONAL OBJECTIVES**
1. To introduce the biosafety regulations and ethical concepts in biotechnology
2. To emphasize on IPR issues and need for knowledge in patents in biotechnology

.
**BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS IN INDIA**
Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, 1989).

**BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS AT INTERNATIONAL LEVEL**
Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs-Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- status of implementation in India.

**BIOETHICS**
What is bioethics? The legal and socioeconomic impacts of biotechnology-Public education of the process of biotechnology involved in generating new forms of life for informed decision-making – ethical concerns of biotechnology research and innovation.

**INTELLECTUAL PROPERTY RIGHTS**
Intellectual property rights-TRIP- GATT-International conventions patents and methods of application of patents-Legal implications-Biodiversity and farmer rights

**PATENTS AND PATENT LAWS**
Objectives of the patent system - Basic principles and general requirements of patent law-biotechnological inventions and patent law-Legal development-Patentable subjects and protection in biotechnology-The patenting living organisms.

**REFERENCES:**

1. Beier, F.K., Crespi, R.S. and Straus, T. *Biotechnology and Patent protection*-Oxford and IBH Publishing Co. New Delhi.
2. Sasson A, *Biotechnologies and Development*, UNESCO Publications.
3. Singh K, *Intellectual Property rights on Biotechnology*, BCIL, New Delhi
4. *Regulatory Framework for GMOs in India* (2006) Ministry of Environment and Forest, Government of India, New Delhi
5. *Cartagena Protocol on Biosafety* (2006) Ministry of Environment and Forest, Government of India, New Delhi


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0404** | **BIONANOTECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course deals with applications resulting from the combination of biotechnology and nanotechnology in the fields of medicine and environment

**INSTRUCTIONAL OBJECTIVES**
To focus on principles of Bionanotechnology and its applications

**INTRODUCTION TO BIONANOTECHNOLOGY**
From Biotechnology to Bionanotechnology-Bionanomachines in action-Modern Biomaterials –The Legacy of Evolution

**BIOMOLECULAR DESIGN AND BIOTECHNOLOGY**
Recombinant DNA technology-Monoclonal antibodies-Biomolecular structure determination-Molecular Medicine

**FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY**
Information –Driven Nanoassembly-Energetics-Chemical transformation-Regulation-Biomolecular Motors-Biomolecular sensing- Self-replication- Machine –Phase Bionanotechnology

**NANOMEDICINE**
Anti-AIDS drugs-Immunotoxins as cell killers-Artificial blood- Cyclic peptides from nanotubes

**APPLICATIONS OF BIONANOTECHNOLOGY**
Harnessing molecular Motors-DNA computers-Molecular design using Biological selection-Artificial life-Hybrid materials-Biosensors

**TEXT BOOK:**

*Bionanotechnology* by David S.Goodsell, 2004, Wiley Publications. Pages-337.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0406** | **PROJECT WORK** | **0** | **0** | **16** | **8** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

## ELECTIVES

### I. Medical Biotechnology

| BT0325 | CANCER BIOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
To provide knowledge about biological aspects of cancer

**INSTRUCTIONAL OBJECTIVES**
To impart basic concepts of cancer biology, various stages in carcinogenesis, molecular cell biology of cancer, cancer metastasis, and cancer therapy.

**FUNDAMENTALS OF CANCER BIOLOGY**
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.

**PRINCIPLES OF CARCINOGENESIS**
Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis.

**PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER**Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes. Oncogenes / Proto Oncogenes activity. Growth factors related to transformations.

**PRINCIPLES OF CANCER METASTASIS**
Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion.

**CURRENT STRATEGIES FOR CANCER THERAPY**
Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.

**TEXT BOOKS :**

1. King R.J.B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W., *Cancer Biology*, Oxford University Press, Oxford, 1995.


**REFERENCES :**

1. Maly B.W.J., *Virology a practical approach*, IRL press, Oxford, 1987.
2. Dunmock.N.J and Primrose S.B., *Introduction to modern Virology*, Blackwell Scientific Publications, Oxford, 1988.


| BT0376 | DRUG AND PHARMACEUTICAL BIOTECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The goal is to emphasize the importance of pharmaceutical research and its usefulness in biotechnology.

**INSTRUCTIONAL OBJECTIVES**
To impart basic concepts of drug metabolism and pharmokinetics, manufacturing principles, and product development and its quality.

**INTRODUCTION**
Development of Drug and Pharmaceutical Industry – Therapeutic agents, their use and economics; Regulatory aspects.

**DRUG METABOLISM AND PHARMACOKINETICS**
Drug metabolism-physico-chemical principles, radio activity-pharmacokinetic action of drugs in human bodies.

**IMPORTANT UNIT PROCESSES AND THEIR APPLICATIONS**
Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture.

**MANUFACTURING PRINCIPLES**
Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquids-injections-ointment-topical applications, Preservation, analytical methods and test for various drug and pharmaceuticals, packing-packing techniques, quality management, GMP.

**PHARMACEUTICAL PRODUCT AND THEIR CONTROL**
Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, biologicals, hormones.

**REFERENCE BOOKS:**

1. Leon Lachman et al *Theory and Practice of Industrial Pharmacy*, 3 Edition, Lea and Febiger, 1986
2. Remington's *Pharmaceutical Science*, Mark Publishing and Co.


| BT0378 | MOLECULAR MODELING AND DRUG DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The goal is to emphasize the importance of drug design and molecular basis of drug design.

**INSTRUCTIONAL OBJECTIVES**
To impart basic concepts in the field of drug design followed by advanced methodology in the molecular aspects of drug design.

**EMPIRICAL FORCE FIELDS MOLECULAR MECHANISM**
Bond Stretching – Angle Bending – Torsional terms – Out plane bonding motions – Electrostatic interactions – Van Der Waals interactions – Effective pair Potentials – Hydrogen Bonding – Simulation of liquid water.

**COMPUTER SIMULATION METHODS :**
Calculation of thermodynamic properties – Phase space – Practical aspects pf computer simulation – Boundaries monitoring Equilibrium – Long range Process – Analyzing result of simulation and estimating errors.

**MOLECULAR DYNAMICS SIMULATION METHODS**
Molecular Dynamics using simple modules – Molecular Dynamics with continuous potentials – Running Molecular Dynamics simulation – Constant dynamics – Time dependent properties – Molecular Dynamics at constant temperature and pressure - Monte Carlo simulation methods.

**METROPOLIS METHODS :**
Monte Carlo simulation of molecules – Monte Carlo simulation of polymers – Calculating chemical potentials – Monte Carlo or Molecular Dynamics, Molecular modeling to discover and design new molecules.

**MOLECULAR MODELING IN DRUG DISCOVERY**
Deriving and using 3D Pharma cores – Molecular docking – Structure Based methods to identify lead components- De novo ligand design.

**REFERENCE BOOKS**

1 A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
2 J.M. Haile , Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0415** | **STEM CELLS IN HEALTH CARE** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The course offers an opportunity to understand the basics of stem cells Embryonic stem cells, Adult stem cells and genetic engineering of stem cells and their applications

**INSTRUCTIONAL OBJECTIVES**

To make the student gain knowledge in

1. Stem cell basics
2. Growing of ES cells in lab
3. Differentiation of stem cells
4. Application of stem cells

**STEM CELL BASICS**

Unique properties of stem cells – embryonic stem cells - adult stem cells – umbilical cord stem cells – similarities and differences between embryonic and adult stem cells. Properties of stem cells – pluripotency – totipotency

**EMBRYONIC STEMCELLS**

*In vitro* fertilization –culturing of embryos-isolation of human embryonic stem cells – blastocyst – inner cell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells.

**ADULT STEM CELLS**

Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.

**STEM CELL IN DRUG DISCOVERY AND TISSUE ENGIEERING**

Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – stem cell based drug discovery, drug screening and toxicology.

**GENETIC ENGINEERING AND THERAPEUTIC APPLICATION OF STEM CELLS**

Gene therapy – genetically engineered stem cells – stem cells and Animal cloning – transgenic animals and stem cells – Therapeutic applications – Parkinson disease - Neurological disorder – limb amputation – heart disease - spinal cord injuries – diabetes –burns - HLA typing- Alzheimer's disease –tissue engineering application – production of complete organ - kidney – eyes - heart – brain.

**REFERENCE BOOKS**

1. *Embryonic Stem cells* by Kursad and Turksen. 2002.Humana Press.
2. *Stem cell and future of regenerative medicine*. By committee on the Biological and Biomedical applications of Stem cell Research.2002.National Academic press

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0417** | **MEDICAL BIOTECHNOLOGY-LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The laboratory is designed to train the students in practical aspects of understanding stem cells Embryonic stem cells, Adult stem cells and genetic engineering of stem cells and their applications

**INSTRUCTIONAL OBJECTIVES**

To make the student gain knowledge in

1. Stem cell basics
2. Growing of ES cells in lab
3. Differentiation of stem cells
4. Application of stem cells

**LIST OF EXPERIMENTS**

STEM CELL LAB

1.Isolation of stem cells from bone marrow
2. Characterisation of stem cells by markers
3. In vitro differentiation stem cell to different kinds of cells
4.Identification of cell type by PCR /RT-PCR
5. SDS –PAGE analysis of protein profile of stem cells
6. MHC alleles of isolated stem cells
7. RAPD finger printing of stem cells
8. Cryopreservation of stem cells
9. Revival of stem cell from cryopreservation and viable cell counting
10. Karyotype analysis of Stem cells

**REFERENCE BOOK**

*Laboratory manual*

**II. Plant Biotechnology**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0327** | **PHYTOCHEMICAL TECHNIQUES** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course creates the knowledge about modern phytochemical techniques of plant analysis

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the different methods of plant analysis
2. To establish the complete knowledge about the phytochemical compounds
3. To create complete knowledge latest on new phytochemical techniques

**METHODS OF PLANT ANALYSIS**

Introduction- Methods of extraction and isolation, methods of separation, methods of identification, analysis of results and applications

**PHENOLIC COMPOUNDS AND TERPENOIDS**

Introduction – Phenols and phenolic acids, phenylpropanoids, flavonoid pigments, anthocyanins, flavaonols and flavones, Tanins, Quinones. Essential oils, diterpenoids and gibberellins, triterpenoids, steroids and catotenoids

**ORGANIC ACIDS, LIPIDS AND NITROGEN COMPOUNDS**

Plant acids, Fatty acids and lipids, Alkanes and related hydrocarbons, polyacetylenes, sulphur compounds. Nitrogen compounds-Amino acids, Amines, Alkaloids, Cyanogenic glycosides, Inoles, Purines, pyrimidines and cytokinins, chlorophylls.

**SUGARS AND THEIR DERIVATIVES**

Introduction- Monosaccharides, Oligosaccharides, Sugar alcohols and cyclitols

**MACROMOLECULES**

Introduction – Nucleic acids, Proteins, Polysaccharides

**TEXT BOOK**

"*Phytochemical Methods*" – A guide to modern techniques of plant analysis. J. B. Harbone. Springler publications, third edition. 2005.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0380** | **INDUCIBLE GENE EXPRESSION IN PLANTS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course provides complete knowledge about the various methods of gene expression studies in plants.

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the plant genome structure.
2. To create complete knowledge about the various gene expression methods
3. To develop knowledge about the applications of the expression studies

**PLANT GENOME STRUCTURE**

Introduction- Classes of DNA in the nuclear genome, Structure of nuclear genes, control of gene expression. Chloroplast genome – organization, inheritance and expression. Mitochondria genome – organization, expression, male sterility. Transposons – Ac and Ds transposable elements in maize, transposon tagging and retrotransposons.

**TN10 ENCODED TETRACYCLINE REPRESSOR AND ECDYSTEROID AGONIST**

Tn10 encoded Tet repressor (TetR) – to repress and to activate plant gene expression. Ecdysteroid Agonist inducible control of gene expression in plants.

**GLUCOCORTICOID AND COPPER CONTROLLABLE GENE EXPRESSION**

Introduction – Regulatory mechanism of the GR, GVG system- construction, induction experiments, characteristics and prospects of steroid inducible system. Copper controllable expression system- Basis and functioning, modifications to overcome background expression in roots, vectors for CC gene expression, Tissue specific antisense experiments, conditional lethal genes and practical uses

**HEAT SHOCK PROMOTERS**

Introduction – Developmental expression- pollen, embryo, floral parts. Constitutive promoters. Organization and types of Heat shock promoters, Heat shock transcription factors, heat shock promoter in transgenic plants – examples.

**WOUND INDUCIBLE GENES AND HORMONE RESPONSIVE ELEMENTS**

Introduction – Multiple phases of wound response, Mechanism of wound induction, Additional hormone factors. Hormone responsive elements- THE ocs/as-1 AuxRE, Natural composite AuxREs, Synthetic composite and simple AuxREs, Control of gene expression.

**TEXT BOOK**

"*Inducible gene expression in plants*" P. H. S. Reynolds. CABI publications.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0382** | **PATHOGENESIS-RELATED PROTEINS IN PLANTS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course provides complete knowledge about the various pathogenesis-related (PR) proteins in plants

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the pathogenesis related plant proteins
2. To create complete knowledge about the different types of PR proteins and its mode of action
3. To develop knowledge about the role of PR proteins in Transgenic plants

**PR PROTEINS AND ITS FUNCTIONS**

Introduction- induction of PR proteins, occurrence and properties of PRs and PR like proteins, Functions of PR proteins.

**PR-1 AND PR-2 PROTIENS**

PR-1-Introduction- Characterization-acidic, Basic proteins, proteins from other organisms, functions. Expression – pathogens/wounds, salicylic acid, ethylene and other hormones, UV light and developmental stimuli. PR-1 promoter analysis. PR-2- Introduction- Structural classes of β-1,3-Glucanases and PR-2 Nomenclature, Biological functions of β-1,3-Glucanases, Regulation of β-1,3-Glucanases expression.

**PLANT CHITINASES, PR-5 AND PR-6 FAMILY**

Introduction-PR-3, 4, 8, 11- Structure of proteins, catalytic mechanisms and specificities, structure and regulation of the genes, fuctions.PR-5-Occurece, biological properties of TLPs, regulation of TLP expression, cDNAs and genes for TLPs. PR-6- Occurrence and structure of plant proteinase inhibitors, Plant microbe interaction, Plant insect interaction and its regulation.

**PATHOGEN INDUCED PR GENE EXPRESSION AND RIP**

Introduction – Signals and putative receptors that activate PR gene expression, PR gene activation by pathogens, transcriptional regulation and genetic studies of PR gene expression. Ribosome inactivating proteins – structure, function and engineering.

**PLANT DEFENSINS AND PR GENES IN TRANSGENIC PLANTS**

Introduction – Protein structure, antimicrobial activities, structure activity relationships, mode of action, expression of plant defensin genes and its contribution for host defense. Transgenic plants – over expression of PR proteins – antifungal and insecticidal proteins, PR proteins in Rice, Co-suppression of PR protein genes in transgenic plants.

**TEXT BOOK**

"*Pathogenesis –Related Proteins in plants*", Swapan K. Datta and Subbaratnam Muthukrishnan. 1999. CRC Press. New York.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0419** | **PLANT HORMONES AND SIGNAL TRANSDUCTION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The main purpose of this subject is to create basic awareness about signal transduction of plant hormones

**INSTRUCTIONAL OBJECTIVES**

1. To introduce plant hormones
2. To create complete knowledge about the synthesis and transport of plant hormones.
3. To introduce the signal transduction of plant hormones.

**AUXIN – THE GROWTH HORMONE**

Introduction – The emergence of the auxin concept, biosynthesis and metabolism of auxin, auxin transport, physiological effects of auxin, developmental effects of auxin and signal transduction pathways of auxin.

**GIBBERELLINS – REGULATORS OF PLANT HEIGHT**

The discovery of the gibberellins, effects of gibberellin on growth and development, Biosynthesis and metabolism of gibberellin, physiological mechanisms of gibberellin-induced growth, signal transduction – cereal aleuronic layers.

**CYTOKININS – REGULATORS OF CELL DIVISION**

The discovery, identification and properties, Biosynthesis, metabolism and transport of cytokinins, biological roles of cytokinins, cellular and molecular modes of cytokinin action.

**ETHYLENE – THE GASEOUS HORMONE**

Structure, biosynthesis and measurement of ethylene, developmental and physiological effects, cellular and molecular modes of ethylene action.

**ABSCISIC ACID – A SEED MATURATION AND ANTISTRESS SIGNAL**

Occurrence, chemical structure and measurement of ABA, developmental and physiological effects of ABA, cellular and molecular modes of ABA action.

**TEXT BOOK**

"*Plant Physiology*", Lincoln Taiz and Eduardo Zeiger. (2003) Third edition. Panima Publishing corporation, New Delhi, Bangalore.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0421** | **PLANT BIOTECHNOLOGY LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The practical course provides complete knowledge about the basic techniques of micropropagation of plants

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the basic steps of micropropagation of medicinal plants
2. To create complete knowledge about the isolation of medicinal important compounds
3. To develop complete knowledge about the cell suspension culture

**LIST OF EXPERIMENTS :**

1. Media preparation and sterilization
2. Callus propagation of medicinal plants and woody plants.
3. Cell suspension culture
4. Isolation and purification of active compounds from plants by column chromatography technique
5. Electroporation
6. Agrobacterium mediated transformation
7. Developing RFLP maps
8. Southern hybridization.

**REFERENCE**

*Laboratory manual*

**III. Food Biotechnology**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **FP0325** | **FOOD FERMENTATION TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

To Impart knowledge and skills related to process technologies and equipment used for the production of various fermented food products

**INSTRUCTIONAL OBJECTIVES**

Students completing this course students should be able

1. To understand various concepts, principles and procedures involved in the area of fermented food production.
2. To familiarize with different fermenters types and their design criteria

**FERMENTATION PROCESS**

Introduction to fermentation – definition – benefit of fermentation – nutritive value of fermented foods – microbial changes in fermented foods – micro organism – proteolytic, liploytic and fermentative bacteria.

**FERMENTATION TYPES**

Selection of industrial importance microorganism -production of single cell protein. Media for industrial fermentation – Medium Composition – Energy, $CO_2$, nitrogen and other growth factors, buffering and foam agents. Types of fermentation – Ethanolic fermentation – mixed alcoholic and acid fermentation – Lactic acid fermentation.

**STERILIZATION**

Sterilization – Principles, sterilization of fermentation media, fermenter – in-batch & continuous process – development of inoculum for industrial fermentation – criteria for transfer of inoculums – aseptic inoculation.

**FERMENTOR 11**

Basic functions of fermenter – Design of fermenter – types of fermenter – different parts – agitator, impellers, aerator, baffles, process control, function and maintenance of various parts of fermenter. Recovery and purifications of food products – filtration – batch and continuous types – fermenter accessories.

**TECHNOLOGY OF FERMENTED FOOD PRODUCTS**

Traditional fermented foods – Curd, yoghurt, dhokla, miso, shrikand, cheese, butter milk, dosa. Modern fermented products – Wine, beer, brandy, vinegar, baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables.

**TEXT BOOK**

1. Stanbury, P.F., Allan Whitaker and S.J. Hall. 1997. *Principles of Fermentation Technology*. Aditya books private Ltd., New Delhi.

**REFERENCE BOOKS**

1. Pederson, C.S. 1971. *Microbiology of food fermentations*, AVI Publishing company. Westport, Connecticut
2. *Biotechnology: Food Fermentation* by V.K, Joshi and Ashok Pandey.

| FP0364 | FOOD MICROBIOLOGY AND CONTAMINATION | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

To make the student to understand the causes of food spoilage and predict the micro organism that can spoil a given food, when prepared, processed and stored under given condition and take corrective measures to control the spoilage and pathogenic micro organism in food.

**INSTRUCTIONAL OBJECTIVES**

Students completing this course should be able

1. To understand the role of beneficial micro organisms in food processing and preservation
2. To list the major food spoilage microorganisms
3. To analyze methods used to control or destroy micro organism commonly found in food.

**MICROBIAL SPOILAGE IN FOODS**

Types of micro organisms in food like meat, poultry, sea foods, vegetables, dairy products, fruits and vegetables .Assessing microbial population in food- meat, poultry, fish and dairy products- microbial spoilage of fruits, vegetables, cereal and bakery products, meat products and egg.

**FOOD PRESERVATION**

Preservation by Moist Heat-Heat Resistance of microorganisms and spores. Decimal reduction time (Dvalues), 12D concept, Thermal Death Time curves. Unit of lethality, determination of process lethality requirements, effective F values. Preservation by low temperature. The behaviour of microorganisms under freezing and refrigeration environment. -Growth and lethal effects of low temperature treatments on microorganisms in raw and processed foods. Preservation by drying. The survival of microorganisms after drying. The microbiology of dried foods. Chemical preservation

**HARMFUL MICRO ORGANISM AND BENEFICIAL MICRO ORGANISM**

Food-borne diseases – food infection and food intoxication – symptoms, causes and control- Micro organisms as food- single cell protein - Fermented food- pickles, sauerkraut- vinegar and lactic acid.

**FOOD SANITATION**

Basic principles of food plant sanitation- cleaning chemicals and sanitizers in the food industry- Indicator organism, coli form bacteria-Hazard Analysis and Critical Control Point (HACCP) Program – Good manufacturing Practices(GMP's) and microbiological standards

**METAL CONTAMINANTS AND ADDITIVES**

Metal contaminants- Sources of health hazard of metallic contaminants – Assessment of food safety – General and acute toxicity – Mutagenicity and carcinogenicity. Indirect and direct Additives - Food allergy, food intolerance, contaminants of processed foods, solvent residue, contaminants of smoked foods.

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**TEXT BOOKS**

1. Frazier, W.C. and Westhoff. *Food Microbiology*. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Jay, J.M. *Modern Food Microbiology*. CBS Publishers& Distributors, New Delhi
3. Pelczar,M.J., E.C.S. Chan and N.R. Krieg, "*Microbiology*", McGraw-Hill New York, 1988
4. Birch, G. and Campbell-Platt, G. (Eds.). 1993. *Food Safety — the Challenge Ahead.* Intercept Ltd., Andover, England.
5. Finley, J., Robinson, S. and Armstrong, D. (Eds.). 1992. *Food Safety Assessment.* American Chemical Society, Washington D.C.

**REFERENCE BOOKS**

1. Banwart, G.J. *Basic Food Microbiology*. Van No Strand Reinhold Publishers, New York.
2. King, R.D. and P.S.J. Cheethame. *Food biotechnology*. Elsevier Applied Science, New York. 1986. Gould, G.W. New methods for food preservation. Blackie Academic & professional Chennai. 1996.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **FP0459** | **THERAPEUTIC NUTRITION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

To impart knowledge about the aspects of diet in the therapy of diseases especially with the increase in obesity and obesity-related diseases.

**INSTRUCTIONAL OBJECTIVES :-**

To enable students to:
1] Know the importance of therapeutic diet.
2] Knowledge about dietary control of different diseases.

Food as a source of nutrients. Study of importance, composition and nutritive value of different foods (cereal grains, millets, pulses, nuts and oil seeds, fruits and vegetables), milk and milk products, meat, egg, poultry, fish, spices and condiments. Classification, source, requirement, deficiencies, and nutritional role of proteins, fats, carbohydrates, minerals, vitamins, water, and roughages.

Utilization of Food: Digestion, absorption and metabolism of proteins, fat and carbohydrates. Basal metabolism and factors affecting basal metabolism. Methods of measurement of Basal Metabolic Rate (BMR). Total energy requirement and factors affecting requirement. Body composition- Definition, importance, classification, methods of assessment of body composition. Energy value of food. Determination of Energy value of food.

Introduction to therapeutic diets. Basic concepts, principles, involved in adoption of normal diet for formulating therapeutic diet, factors considered, classification, use of food exchange groups. Diets during pregnancy, lactation, infancy, school age, adolescent, adulthood and old age.

Planning therapeutic diets and dietary management in case of fever, typhoid, influenza, rheumatic fever, nephritis, peptic ulcer, hypertension, atherosclerosis, liver cirrhosis and hepatitis. Diet in diseases (metabolic disorders, febrile conditions, surgical & other stress conditions) - causes, symptoms, physiological changes and dietary management.

Malnutrition : Causes and effect of malnutrition on the vulnerable section of the society, effect of malnutrition on national development. Measures to combat malnutrition – National nutrition policy and programmes. Role of ICDS, WHO, UNICEF, NIN, NFI, CFTRI, FTRI, NNMB in combating malnutrition.

**TEXT BOOKS**

1. Joshi S. A. '*Nutrition and Dietetics'*, New Delhi, Tata Mc Graw Hill Publishing Co. Ltd.
2. Robinson '*Normal and Therapeutic Nutrition'* New Delhi, Tata Mc Graw – Hill Publishing Co. Ltd.
3. Crampton E.W. and L. E. Lloyd (1915), '*Fundamentals of Nutrition'*, San Francisco W. H. Freeman

**REFERENCE BOOKS:**


1. Davidson S.R, Passmore and J.F. Brock (1986), '*Human Nutrition and Dietetics'* London Churchill, Livingstone
2. Antia F.P (1986), '*Clinical Dietetics and Nutrition'*, Bombay, 3rd edition, Oxford University Press.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **FP0461** | **FOOD MICROBIOLOGY AND FERMENTATION LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course aims at helping the students to gain a good understanding of laboratory practices in food microbiology and become qualified for setting up or working in a food microbiology laboratory in industry.

**INSTRUCTIONAL OBJECTIVES**

Students completing this course should

1. Understand the causes of food spoilage
2. Predict the microorganisms that can spoil food substances.
3. To understand the role of beneficial microorganism in food processing, preservation and safety

**LIST OF EXPERIMENTS**

1. Standard plate count
2. Negative straining technique
3. Structural straining-spore straining
4. Microbial examination of water by multiple tube fermentation test
5. Preparation of media and reagents for biochemical test
6. Vinegar production
7. Microbial examination of egg
8. Bread preparation
9. Wine making
10. Microbial examination of curd
11. Microbial examination of processed fruit and vegetable products
12. Microbial examination of canned foods
13. Hanging drop techniques
14. Assay of quality of milk by methylene blue reduction test.
15. Sauerkrant fermentation
16. Control of microbial growth by physical methods-heat

**REFERENCE**

*Laboratory Manual*

**IV. Environmental Engineering**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0329** | **ENVIRONMENTAL BIOTECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

To make the student to understand the basic concepts of environmental biotechnology.

**INSTRUCTIONAL OBJECTIVES**

Students completing this course should be able

1. To understand the role of various environmental pollutants, biooxidation, biotransformation
2. To know the involvement of microbes in waste water treatment, chemicals

**INTRODUCTION TO ENVIRONMENTAL POLLUTANTS**

Water, Soil and Air: their sources and effects. Removal of Specific Pollutants : Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal Accumulation, Biosorption & detoxification mechanisms.

**MICROBIOLOGY AND BIOCHEMISTRY OF WASTE WATER TREATMENT**
Biological Treatment of anaerobic and aerobic; methanogenesis, methanogenic, acetogenic, and fermentative bacteria- technical process and conditions; Use of Genetically Engineered Organisms. emerging biotechnological processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters,

**BIODEGRADATION OF XENOBIOTIC COMPOUNDS**
Xenobiotic compounds : Aliphatic, Aromatics, Polyaromatic Hydrocarbons, Polycyclic aromatic compounds, Pesticides, Surfactants and microbial treatment of oil pollution.

**BIOTRANSFORMATIONS AND BIOCATALYSTS**
Basic organic reaction mechanism - Common prejudices against Enzymes.- Advantages & Disadvantages of Biocatalysts - Isolated Enzymes versus whole cell systems.- Mechanistic Aspects and Enzyme Sources.- Biocatalytic Application - Catalytic Antibodies; Stoichiometry, kinetics, and thermodynamics of microbial processes for the transformation of environmental contaminants.

**BIOOXIDATION & MICROBIAL LEACHING**
Biooxidation – Direct and Indirect Mechanisms – Biooxidation Kinetics; Bacterial oxidation of Sphalerite, Chalcopyrite and Pyrite.; Extraction of metals from ores; Recovery of metals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.

**REFERENCE BOOKS:**

1. *Environmental Microbiology*, W.D. Grant & P.E. Long, Blakie, Glassgow and London.
2. *Microbial Gene Technology*, H. Polasa (ED.) South Asian Publishers, New Delhi.
3. *Biotreatment Systems*, Vol. 22, D. L. Wise (Ed.), CRC Press, INC.
4. *Standard Methods for the Examination of Water and Waste Water* (14 th Education) , 1985. American Public health Association
5. *Environmental Biotechnology* by Bruce Rittmann and Perry McCarty
6. *Biotransformations* : K. Faber (1995), Springer- Verlag.


| | | L | T | P | C |
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| **BT0384** | **ENVIRONMENTAL MICROBIOLOGY AND BIODIVERSITY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
To impart knowledge on environmental biotechnology dealing with monitoring, types of microorganisms, waste removal, etc.

**INSTRUCTIONAL OBJECTIVES :-**
To enable students to:
1] Know the importance of environmental biotechnology.
2] Knowledge about waste removal and biodiversity

**MICROBIAL ECOLOGY**
Introduction to Environmental Microbiology & Ecology; Interactions among microbial populations - Microbial interactions with plants & animals - Microbial communities : Water-Column Microbes and Biofilms; Sediment Communities and Microbial Mats - Soil and Lithospheric Communities - Microbial Food Web; Biomass and activity of microbes;

**MICROBIAL INTERACTIONS**
Ecosystem function and their relationship to microbes: Global chemical cycles - Microbial mediation and redox biogeochemistry - Stoichiometry and energetics of microbial transformations. Biofilm modeling and Engineering.

**MICROBIAL ECOLOGY AND METAGENOMICS:**
Molecular biology methods - Microbial ecology (Metagenomics); Functional and genetic diversity of microbial communities – In situ gene expression – Signal exchange in microbial communities and between microbes and their host – gene transfer in microbial communities**.**

**EXTREMOPHILES**
Archaea : Archaebacteria and extremophilic microbes – their Biotechnological potentials. Biocatalysts from Extreme Thermophilic and Hyperthermophilic Archaea and Bacteria.

**ENVIRONMENTAL GENOMICS & PROTEOMICS, AND BIODIVERSITY**
New protein diversity from extreme environment (meta)genomes - Functional genome analysis of Alcanivorax borkumensis, an ubiquitous and efficient marine oil-degrader - Physiological proteomics with environmental bacteria - Anaerobic degradation of aromatic compounds: from physiology to functional genomics- Biodiversity principles; Laws relating to biodiversity protection of plant varieties, Agricultural biotechnology, medical biotechnology, Biodiversity act of 2002

**TEXT BOOKS :**
*Brock Biology of Microorganisms* by Madigan, Martinko and Parker; Prentice Hall

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| **BT0386** | **ENERGY ENGINEERING AND TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The course will provide knowledge about different types of energy and development of environment-friendly sources of energy.

**INSTRUCTIONAL OBJECTIVES :-**
To enable students to:
1] Know the various sources of energy.
2] Knowledge about alternate sources of energy/conversion of one source of energy to another.

**ENERGY**
Introduction ; Resources : Renewable and non-renewable resources ( Water, Minerals, and Energy; Use and over-exploitation; Classification and Sources of Energy; Problems relating demand and supply of various energy sources; Coal, Petroleum etc.,

**CONVENTIONAL AND NON- CONVENTIONAL ENERGY**
Conventional fuels- firewood, plant and animal wastes, coal, gas, animal oils, their environmental impact. Modem fuels-methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugars to ethanol, the gasohol experiment, solar energy converters-hopes from the photosynthetic pigments, plant based petroleum industry, cellulose degradation for combustible fuels their environmental impacts.

**BIOGAS PLANT AND ITS DESIGN**
KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes – development in energy routes.

**CLEAN COAL TECHNOLOGY**
Biotechnology and Microbiology of Coal Degradation – Aerobic and Anaerobic pathway of coal degradation- Characterisation/identification of bioconversion substrates and products – Biosolubilization and bioliquefaction of coal- Biodesulfurisation of coal and oil- Mechanisms of coal biosolubilization- Enzymes that depolymerise coal – Recent Advances in Bioprocessing of coal.

**GREEN TECHNOLOGY – MICROBIAL FUEL CELL**
From Microbes to Megawatts – Microbial Fuel Cells - Types of Biological fuel cells – Working Principle - Applications of Biological Fuel cells.

**TEXT BOOKS :**

1. S.B Pandya, "*Conventional Energy Technology - Fuels and chemical Energy* - TMH (1987)
2. S.P. Sharma and Chander Mohan*, Fuels and Combustion*, "TMH, 1984
3. Kash Kori, C., *Energy resources, demand and conservation with special reference to India*, TMH, 1975.

**REFERENCE BOOKS:**


1. Gulp Jr., "*Principles of Energy Conservation*, "MGK (1979)
2. Chemtech I - *Manual of Chemical Technology*, "Vol.I. S. Chand and Co., New Delhi (1985)
3. Pryde P.R., "*Non Conventional energy resources*" JW (1983)
4. Connolly, T.J., "*Foundation of nuclear engineering*" JW (1978)
5. Gray T.J. and Gashos G.K., *Tidel Power*," Plenum Press (1972)
6. Sarkar S. "*Fuels and Combustion*, "Orient Longmans (1974)
7. Duffie T.R. and Beckman, W.A., *'Solar Energy Thermal Processes* " JW (1974).


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0423** | **ENVIRONMENTAL BIOREMEDIATION TECHNOLOGIES** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course will introduce students to the variety of ways in which microbes interact with their immediate surroundings, i.e. soil and water, and plant and animal hosts. It will also demonstrate how microbes have adapted to survive in extreme environments, and how the properties of microbes can be exploited for human benefit.

**INSTRUCTIONAL OBJECTIVES**

1. give an account of the ways in which microbial genes can be tracked in the environment using molecular techniques
2. be able to assess what microbial guild has been responsible for an undesirable incident, suggest the most appropriate course of remedy and suggest how such incidences could be prevented in the future
3. describe the application of environmental microbiological research to other practical problems

**BIOREMEDIATION**

Introduction to Bioremediation, Types of Bioremediation, Bioremediation of surface soil and sludges, Bioremediation of subsurface material, In situ technologies, Ex-situ technologies, Phytoremediation, Bioaugmentation of naturally occurring microbial activities :- Environmental modification- use of co-substrates, oxygen supplementation (Composting and aerobic bioreactors, in situ aeration).

**BIODEGRADATION AND BIOCATALYSIS**

General microbial strategies for initiating attack on xenobiotics - Biodegradation strategies for key classes of compounds - Factors affecting biodegradation; Biodegradation kinetics ; Biodegradation Engineering & Modelling; Biocatalysis Enzymes and major reactions and its kinetics;

**MOLECULAR TECHNIQUES IN BIOREMEDIATION**

Restriction endonucleases, techniques of restriction mapping-vectors-plasmid PBR 322 and Lamda phage, cosmid- construction of chimeric DNA, ligases, gene closing-Southern, northern and western blotting, dot and slot blos-construction of Genomic and cDNA libraries-PCR (polymerase chain reaction) and gene closing - use of genetically altered microorganisms for field biodegradation of hazardous materials.

**BIOTECHNOLOGY FOR HAZARDOUS WASTE MANAGEMENT:**

Introduction - Hazardous wastes-biodegradation of Hazardous wastes - biological detoxification of cyanide - market for hazardous wastes management-biotechnology applications to hazardous wastes management- Source and Management Safety.

**SPECIAL TOPICS IN BIOREMEDIATION TECHNOLOGY**

Environmental Nanotechnology Research - Nanotechnology for Bioremediation of Heavy metals - New Bioremediation Technologies to Remove Heavy Metals and Radionuclides using Fe (III), Sulfate and Sulfur Reducing Bacteria - Bioremediation of Petroleum Sludge using Bacterial Consortium and Biosurfactant - Biofilms in Porous Media: Mathematical Modeling and Numerical Simulations – Biosensor Technology for monitoring pollutants.

**TEXT BOOKS:**

1. Environmental biotechnology, 1995 S.N.Jogdand. Himalaya Publishing House, Bombay, Delhi, Nagpur.
2. Bioremediation 1994 Baker, K.H.and Herson, D.S. McGraw Hill, Inc.New York.
3. Biotechnology biology 1997 P.K.Gupta, Rastogi Publications, Meerut.

**REFERENCE BOOKS**

1. Molecular biology of the gene IV edition Watson, J.D.,Hopkins, N.H., Roberts, J.W.,Steitz, J.A.,Weiner, A.M. The Benjamin- Cummings Publications company Inc.
2. Environmental Bioremediation Technologies by Shree N. Singh; Rudra Tripathi
3. Crawford R.L. Crawford D.L. Bioremediation: Principles and Applications Cambridge Univ. Press, 1996.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0425** | **ENVIRONMENTAL ENGINEERING LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course aims at helping the students to gain a good understanding of laboratory practices in environmental biotechnology.

**INSTRUCTIONAL OBJECTIVES**

Students completing this course should be able

1. Do the analysis for pollutants
2. Analyze the role of the microorganisms in degradation of metallic pollutants.
3. To understand the role of beneficial microorganism in environmental engineering

**LIST OF EXPERIMENTS**

1. Estimation of metals such as Cr, Pb, Hg, Zn, Ni, As, Bi, etc by Atomic Absorbance Spectrophotometer.
2. Monitoring of water quality of- water and waste water treatment plant, effluents and a water body – BOD, COD, DO & TDS.
3. Analysis of organic compounds from soils.
4. Biodegradation of lipids, Cellulose materials, Hydrocarbons, Starch Industry wastes & Lignin.
5. Methods of screening of microorganisms with amylolytic and proteolytic activity.
6. Methods for high throughput cultivation and assay of microorganisms.
7. Construction and use of reporter gene fusions (gfp, lacZ, uidA, ice, luc, lux,)
8. Isolation (solid phase or solvent partitioning extraction) and analytical chemistry of techniques (MS, NMR) for identification of microbial metabolites
9. Genome mining and genome analysis tools
10. Plasmid transfer. Use of self-transmissible plasmids in biotechnology.

**REFERENCE BOOK**

*Laboratory manual*

**V. Enzyme Technology**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0331** | **ENZYME SCIENCE AND ENGINEERING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The course aims to provide knowledge on various topics covering enzymology and engineering of enzymes

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the basic concepts about enzymes, action, and kinetics
2. Advanced information about immobilized enzyme systems and biosensors

**APPLICATION AND CHARACTERISATION OF ENZYMES**

Classification of Enzymes; Commercial application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications. Production and Purification of Crude Enzyme extracts from

plant, animal and microbial sources-some case studies; methods of characterization of enzyme; development of enzymatic assays.

**MECHANISMS AND KINETICS OF ENZYME ACTION**
Mechanism of Enzyme Action; Concept of active site and energetic of enzyme substrate complex formation; Specifically of enzyme action; Kinetics of single substrate reactions; turnover number; estimation of Michaelis – Menten parameters, multi - substrate reactions- mechanism and kinetics; Types of inhibition – kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzyme; Deactivation kinetics

**ENZYME IMMOBILISATION**
Physical and Chemical techniques for enzyme immobilisation – adsorption, matrix entrapment, encapsulation, cross linking, covalent binding etc..-examples; advantages and disadvantages of different immobilization techniques, overview of application of immobilized enzyme systems.

**ENZYME REACTORS**
Design of Immobilized Enzyme Reactors – Packed – bed, Fluidized- bed and Membrane reactors-Application and advantages

**ENZYME BIOSENSORS**
Application of enzyme in analysis; Design of enzyme electrodes and their application as biosensors in industry, health care and environment.

**TEXT BOOKS**
1 *Enzymes* by Trevor palmer
2 *Biochemistry* by Jeremy M.Berg, John L.Tymozko, Lubert Styer, Fifth edition, W.H.Freeman and Company, 1514 pages.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0388** | **METABOLIC ENGINEERING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The course aims to empower the students with the knowledge on metabolic engineering.

**INSTRUCTIONAL OBJECTIVES**
1. To introduce the basic concepts about enzymology followed by primary and secondary metabolites biosynthesis.
2. To emphasize the importance of bioconversions of substances and the regulation of enzyme production

**INTRODUCTION**
Induction-Jacob Monod Model, catabolite regulation, glucose effect, camp deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, permeability control passive diffusion, facilitated diffusion, active transport group transportation.

**SYNTHESIS OF PRIMARY METABOLITES**
Alteration of feed back regulation, limiting accumulation of end products, feed back, resistant mutants, alteration of permeability.

**BIOSYNTHESIS OF SECONDARY METABOLITES**
Precursor effects, prophophase, idiophase relationships, enzyme induction, feed back regulation, catabolite regulation by passing control of secondary metabolism, producers of secondary metabolites.

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

**REGULATION OF ENZYME PRODUCTION**
Strain selection, improving fermentation, recognizing growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

**REFERENCE BOOKS**

1. Wang D. I. C., Cooney C. L., Demain A. L., Dunnil P., Humphrey A. E., Lilly M. D., Fermentation and Enzyme Technology, John Wiles and Sons., 1980.
2. Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Zubay G., Biochemistry, Macmillan Publishers, 1989.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0427** | **RECOMBINANT ENZYME AND THERAPEUTIC AGENTS PRODUCTION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The course will focus on the impact of the recombinant therapeutic agents including enzymes in health care.
.

**INSTRUCTIONAL OBJECTIVES :-**
1. knowledge of a) the structure and metabolism of cells; and b) the transmission and expression of genetic information.
2. specialized knowledge in one or more disciplines of molecular and cell biology, biotechnology and genetic engineering
3. new and existing methods and technologies in these disciplines.

**INTRODUCTION**
Molecular biotechnology revolution-Molecular biotechnology molecular systems-DNA, RNA, Protein synthesis-

**RECOMBINANT DNA TECHNOLOGY**
Recombinant DNA and its technology-Chemical synthesis and sequencing-PCR-Manipulation of gene expression-Heterologous protein production-Directed mutagenesis-Protein Engineering

**MOLECULAR BIOTECHNOLOGY OF MICROBIAL SYSTEMS**
Molecular diagnostics-Pharmaceuticals, enzymes, monoclonals-Production of antibodies in E. coli, nucleic acids as therapeutic agents, treating genetic disorders, prodrug activation-Vaccines- Large-scale Production of proteins from recombinant microorganisms-Microbial insecticides

**EUKARYOTIC SYSTEMS**
Genetic Engineering of Plants: Methodology-Genetic Engineering of Plants: Applications-Transgenic Animals-Human Molecular Genetics

**REGULATION OF MOLECULAR BIOTECHNOLOGY**
Regulation, the use and patenting, the applications of molecular biotechnology

**TEXT BOOK**
*Molecular Biotechnology*, 3rd edition, by Glick and Pasternak, 2003.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0429** | **ENZYME TECHNOLOGY LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This course aims at educating students about the practical aspects of enzyme engineering .

**INSTRUCTIONAL OBJECTIVES**
**Students completing this course should** Understand the extraction of enzymes, enzyme kinetics, and enzyme reactions

**LIST OF EXPERIMENTS**

1. Isolation of high yielding microbial strains for the production of commercially important enzymes.
2. Production of commercially important enzymes from microbial sources.
3. Standardization of medium composition for the optimum production of enzymes.
4. Determination of enzyme activity and specific activity.
5. Partial purification of isolated enzymes.
6. Characterization of enzymes-Effect of pH ,temperature and inhibitors on enzyme activity etc.
7. Molecular weight determination of enzyme by Gel filtration method.
8. Method of checking the purity of the enzyme -SDS-PAGE
9. Immobilization of enzymes –Different Techniques such as adsorption, entrapment, encapsulation and cross- linking.
10. Strain improvement techniques- physical, chemical and genetic manipulation methods.
11. Development of enzyme assay methods.
12. Formulation of enzyme stability.

**REFERENCE**

*Laboratory Manual*

**REFERENCE BOOK**

R. Eisenthal and M.J. Dansen, "Enzyme Assays –A PracticalApproach", IRL Press, Oxford University Press, Oxford, 1993

**VI. Biophysical Engineering**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0333** | **COMPUTATION OF BIOLOGICAL MOLECULES** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The goal of this course is to train the students to bridge the gap between the biological data and the computational methods needed to maximize the utility of that data. The course promotes understanding of biological molecules in order to use them as models for new computing paradigms. It starts with a qualitative introduction to quantum mechanics, progressing to molecular mechanics methods and biological applications, including protein folding and docking.

**INSRUCTIONAL OBJECTIVES**

To enable the student to

1. Apply simulations to the study of problems such as protein folding, docking, prediction of protein-protein interaction networks.
2. To understand the approaches to do equilibration, sampling, free energy computation and kinetics of biological molecules.
3. To understand combinatorial approaches for solving biological network problems.

**INTRODUCTION TO COMPUTATIONAL BIOPHYSICS AND MACROMOLECULES**

Protein folding, protein – ligand and protein- protein docking, Biological networks: protein interaction networks.

**MOLECULAR DYNAMICS**

Introduction to molecular dynamics, equilibration and convergence, molecular dynamics ensembles: Langevin dynamics vs. Nose like thermostats.

**CONFORMATIONAL SAMPLING**

Multicanonical approaches, parallel tempeing\ replica exchange, capturing rare events, free energy computation.

**LONG TIME DYNAMICS**

Multiple time stepping integrators, elastic network methods, finding reaction paths, comparison to experiments: NMR and X-ray crystallography. Modeling salvation for biomolecules.

**PROTEIN INTERACTION NETWORKS**

Kinetics of protein folding, inferring protein interaction networks, validating protein interactions experimentally and computationally.

**TEXT BOOK:**

*Molecular Modeling and Simulation: An Interdisciplinary Guide*, Springer- Verlag, 2002.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0490** | **BIOPHYSICAL METHODS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course is aimed to introduce the theory and application of modern experimental methods in biophysical chemistry, with particular emphasis on structural techniques.

**INSTRUCTIONAL OBJECTIVES**

The objectives of the course are

1. To provide detailed theoretical instructions on the methodology of X-ray crystallography, a biophysical technique at the forefront of research efforts aimed at structure-function elucidation of macromolecules.
2. Students will learn the theory behind the technique of X-ray crystallography and will apply the knowledge obtained to the three-dimensional structure determination of macromolecules.

**INTRODUCTION TO BIOLOGICAL MACROMOLECULES**

Biological Macromolecules -Molecular interactions, overview of thermodynamics.

**MACROMOLECULAR STRUCTURE DETERMINATION BY X-RAY CRYSTALLOGRAPHY**

:X-ray diffraction, Bragg's law, von Laue conditions, reciprocal space, Fourier Transforms, electron density and Structure factor F(hkl), phase problem, Patterson maps, fiber (DNA) diffraction.

**LIGHT SCATTERING, SEDIMENTATION, HIGHER ORDER DNA STRUCTURE, SCATTERING SUPPLEMENT, POLARIZATION IN LIGHT SCATTERING**

Sedimentation, mass spectrometry, Gel electrophoresis (Fick's Law), Light Scattering (Classical, Dynamic, Polarized), DNA Topology (Length, Twist, and Writhe), Chromosome Structure.

**ABSORPTION SPECTROSCOPY, PROTEIN STRUCTURE**

UV, VIS spectroscopy, linear and circular dichroism, Protein primary, secondary, tertiary, quaternary structure, NMR

**EMISSION SPECTROSCOPY**

Fluorescence (phenomenon), Fluorescence microscopy, native fluorophores in proteins, solvent effects, Quantum yield, fluorescence decay, FRET (resonance energy transfer), linear polarization of fluorescence and emission anisotropy, Perrin plots.

**TEXT BOOKS:**

1.*Principles of Physical Biochemistry*, by K.E. van Holde, W. C. Johnson, and P.S. Ho
2.*Molecular Biophysics* by Igor N. Serdyuk , Nathan R. Zaccai , Joseph Zaccai .

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0431** | **MACROMOLECULAR INTERACTION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE :**

The goal of this course is to provide insight into the interactions of biological molecules that determine the structure of membrane proteins, nucleic acids and to provide relationship between structures -function of large biomolecules in the cellular context.

**INSTRUCTIONAL OBJECTIVES**

1. To make the students to understand and predict the properties of large biomolecules and systems, which are crucial for biological functioning.
2. To understand the mechanism of macromolecular interaction.

**INTRODUCTION TO BIOLOGICAL MACROMOLECULES**

General principles , Molecular interactions in macromolecular structures

**EQUILIBRIUM BINDING**

Boltzmann distributions and energy levels. Ligand-protein interactions, protein-protein interactions. Binding polynomials and partition functions; linked functions; coupled equilibriums. Phenomenological binding models vs. rigorous models of allosteric regulation and site-site cooperativity. Practical considerations of binding analysis; non-linear least squares analysis. ITC, DSC and SPR methods .

**NUCLEIC ACIDS**

Special properties of nucleic acids; counterion condensation theory; effect of salt concentration and type on nucleic acid structure and nucleic acid-protein interactions. RNA structure and folding. Single-molecule nucleic acid biophysics.

**BINDING AND TRANSPORT AT MEMBRANE SURFACES**

Thermodynamics of ligand binding and ligand-linked oligomerization (clustering) of proteins in model lipid bilayers and membranes. Structural principles, physical chemistry and allostery of ABC (ATP-binding cassette) transporters and voltage-gated K+ and Cl- channels.

**SINGLE MOLECULE SCIENCE**

Mechanisms of protein-ligand (nucleic acid) and protein-protein interactions; dynamics of intramolecular structural changes; single-molecule FRET; single-molecule force spectroscopy monitored by laser optical tweezers and atomic force microscopy.

**TEXT BOOKS:**

1.*Thermodynamic Theory of Site-Specific Binding Processes in Biological Macromolecules*, DiCera (Cambridge University Press, 1995);
2.*Molecular Driving Forces:Statistical Thermodynamics in Chemistry and Biology*, Dill and Bromberg (Garland Sciences, 2003).

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0433** | **BIOPHYSICAL ENGINEERING LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

This course aims at educating students about the practical aspects of biophysical engineering .

**INSTRUCTIONAL OBJECTIVES**

Students completing this course should be able to do techniques associated with biophysical engineering including protein-ligand interaction

**LIST OF EXPERIMENTS**

1.UV-Visible spectroscopy
2. Fluorescence spectroscopy
3.Mathematical modeling to study antibody binding.
4.Measurment of conformational stability of protein.
5. Determination of secondary structure of protein by Circular dichroism (CD) spectroscopy.
6. Intracellular Ca2+ measurements.
7. Mass spectroscopy
8. Modeling biomolecules by computer simulations and graphics.
9. Denaturation of proteins and nucleic acids.
10. Determination of Protein- ligand interaction.

**REFERENCE**
*Laboratory Manual*

**VII Fermentation technology**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0335** | **FERMENTATION TECHNOLOGY AND APPLICATIONS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**
This course helps the students to acquire knowledge about fundamentals of fermentation technology

**INSTRUCTIONAL OBJECTIVES:**
1. Describe current knowledge in biological and biochemical technology.
2. Comprehend growth and metabolism; genetics and metabolic engineering.
3. Examine eukaryotic and prokaryotic protein expression relevant to industrial practice; post-translational modification: glycosylation.
4. Assess power requirements in bioreactors; modeling of bioprocesses;

**GENERAL INTRODUCTION**
Chronological Development of Biotechnology- Biocatalysis; comparison with synthetic catalysts, Mechanisms, Michaelis-Menten Model for Saturation kinetics. Enzyme Immobilization- Complex and synthetic media, Selection of components, buffers, precursors, pH adjustment

**MEDIA/AIR STERILIZATION AND DEATH KINETICS**
Media & Air: Batch & Continuous In-situ sterilization in fermenter- Enrichment culture, Screening Methods, Culture preservation, Strain improvement**:** Mutagenesis, Protoplast fusion and r-DNA technology-

**FERMENTATION: MICROBIAL GROWTH & PRODUCT FORMATION**
Aseptic culture transfer & incubation, inoculum age/size, studies on growth kinetics in batch-continuous & fed-batch cultures, Applications-Primary & Secondary metabolism and important biotechnological products and implications-Ideal bioreactors, Various configurations, Mechanical construction**:** various parts & accessories, Introduction to Mass & Heat Transfer: Agitation and aeration, Modes of Reactor Operations. Instrumentation and control of bioprocesses, Demonstration of various parts with the Laboratory Fermenter.-cell disruption-cell separation-cell and filtrate processing

**INDUSTRIAL BIOTECHNOLOGY**
Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)-Microbial Transformations, Microbial leaching

**TREATMENT OF BIOLOGICAL WASTES**
Wastewater characteristics, Principles of sewage treatment & BOD removal: aerobic & anaerobic

**TEXTBOOK:**
*Principles of Fermentation Technology*" by Stanbury, Whitaker & Hall, (1997) Aditya Books (P) Ltd., New Delhi[Original Publisher:Butterworth & Heinemann (1995)]

**REFERENCE BOOKS**

1. "*Biotechnology: A Text Book of Industrial Microbiology*" 2nd Edition, by W. Crueger & A. Crueger (2000) Panima Publishing Corporation, New Delhi/Bangalore.
2. "*Bioprocess Engineering*" by M. Shuler and F. Kargi (2002) Prentice Hall of India Pvt. Ltd., New Delhi.
3. *Fermentation and Biochemical Engineering Hand Book* (second edition) H. C. Vogel and C.L Todaro Noyes Publication (1997) New Jersy, USA.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0392** | **DISTILLATES AND FERMENTATION TECHNOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**

This course gives in depth knowledge on production of Malt and Grain Whisky and Batch and Grain whisky distillation and marketing

**INSTRUCTIONAL OBJECTIVES:**

1. To make the students to understand different whiskies.
2. To make them to understand the technology of Batch and Grain Whisky distillation.
3. To make them to know about whisky analysis and marketing.

**MALT WHISKIES**

Scotch Whiskey – Irish Whiskey – North American Whiskies – Japanese Whiskey
malt whiskies-Raw materials and processing – Barley – Peat – Malting – Kilning – Malt – Specification – Friability – Fementability – Milling, Mashing and wort recovery

**GRAIN WHISKY**

Raw materials – wheat- wheat breeding- Grain distillery processing- Gelatinization – Milling- Cooking Conversion – Wort Separation – Future developments.

**YEAST & FERMENTATON**

Yeast for alcohol fermentation – Yeast biochemistry -Yeast Structure – carbohydrate metabolism – Nitrogen metabolism – Fatty acid and ester production – cultivation of distillery yeast – Contamination.

**BATCH & GRAIN WHISKY DISTILLATION**

Design – Wash Still Operation – Sprit Still Operation – Continuous Distillation – Design and Operation of grain whisky stills – Maturation & blending - coproducts

**WHISKY ANALYSIS**

Whiskies of world and their regulations – scotch Whisky- Canadian Whisky – Major Volatile Congeners – Whisky age- Sensory analysis – Whisky authenticity – Marketing Scotch Whisky

**TEXTBOOK:**

*Whisky- Technology, Production and Marketing* by Inge Russell, Graham Stewart, Charlie Bamforth, Elsevier,2003.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0435** | **BREWING SCIENCE AND PRACTICE** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**

This course gives in depth knowledge on Beer Production, Chemical and Physical Properties of Beer and its Packaging.

**INSTRUCTIONAL OBJECTIVES:**

1. To make the students to understand brewing.
2. To make them to understand the physical and chemical properties of beer and packaging.
3. To make the students to get knowledge about wort fermentation.

**OUTLINE OF BREWING**

Introduction – Malts – Brewing liquors – Milling and Mashing- Processing of Beer – types of beer – malting – water, effluents and wastes.

**SCIENCE OF MASHING**

Introduction – Mashing schedules – Altering Mashing Conditions – Mashing Biochemistry – Mashing and Beer flavour – Spent Grains – Preparation of grists – Mashing technology.

**WORT BOILING**

Introduction – Chemistry of wort boiling – Clarification, Cooling and Aeration.

**WORT FERMENTATION**
Basic principles – Bottom and top Fermentation Systems – Continuous Fermentation – Fermentation Control Systems, Beer Maturation– flavour and aroma changes - Stabilization against non biological haze – Carbonation – Clarification and filtration – Special beer treatments.

**CHEMICAL AND PHYSICAL PROPERTIES OF BEER**
Chemical Composition – Nutritive value – Colour – Haze – Viscosity – foam Characteristics – gurting flavour – Semors analysis – Packaging.

**TEXTBOOK:**
*Brewing – Science and Practice* by Dennis E. Briggs, Chris A. Boulton, Peter A. Brookers and Roger Sterens, Wood head Publishing Limited, 2004.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0437** | **FERMENTATION TECHNOLOGY LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
Enable the student to understand the practical aspects of fermentation technology

**INSTRUCTIONAL OBJECTIVES**
To impart knowledge about enzyme kinetics, fermenters, and industrial biotechnology

**LIST OF EXPERIMENTS**
1. Enzyme kinetics
2. Fermentation methods
3. Product recovery and Purification
4. Beer and Whisky making

**REFERENCE BOOK**
*Laboratory manual*

**VIII. Bioinformatics**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0337** | **BIOINFORMATICS ALGORITHMS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The purpose of this subject is to study various Algorithm design techniques and applying it in Bioinformatics

**INSTRUCTIONAL OBJECTIVES**
1. Notation and different types of Algorithms
2. Mapping Algorithms and Greedy approaches.
3. Dynamic programming for sequence alignment
4. DNA analysis using graph Algorithms.
5. Clustering and trees.

**INTRODUCTION** **6**
Algorithms and Complexity- Biological algorithms versus computer algorithms – The change problem –Correct versus Incorrect Algorithms – Recursive Algorithms – Iterative versus Recursive Algorithms – Big-O Notations – Algorithm Design Techniques.

**GREEDY ALGORITHMS**
Molecular Biology Primer – Exhaustive Search – Mapping Algorithms – Motif-Search Trees – Finding Motifs – Finding a Median String – Greedy Algorithm – Genome Rearrangements – Sorting by Reversals – Approximation Algorithms – A Greedy Approach to Motif Finding.

**DYNAMIC PROGRAMMING ALGORITHMS**
DNA Sequence comparison – Manhattan Tourist Problem – Edit Distance and Alignments – Longest Commons Subsequences – Global Sequence Alignment – Scoring Alignment – Local Sequence Alignment – Alignment with Gap Penalties – Multiple Alignment-Gene Predictions – Approaches to Gene Prediction - Spiced Alignment – Divide and Conquer Algorithms.

**GRAPH ALGORITHMS**
Graphs – Graphs and Genetics – DNA Sequencing – Shortest Superstring Problem – DNA arrays as an alternative sequencing techniques – Sequencing by Hybridization – Path Problems – Fragment assembly in DNA Sequencing – Protein Sequencing and Identification – The Peptide Sequencing Problem – Spectrum Graphs – Spectral Convolution and Alignment – Combinatorial Patter matching.

**CLUSTERING AND TREES**
Clustering and trees – Gene expression analysis – Hierarchical clustering-k-means clustering – Clustering and corrupted Cliques – Evolutionary Trees – Distance-based tree reconstruction – Reconstruction trees from additive matrices – Evolutionary trees and hierarchical clustering – Character-based tree reconstruction – Small and large Parsimony Problem – Hidden Markov Models- Randomized Algorithms.

**TEXTBOOKS**
1. Neil C. Jones and Pavel A. Pevzner, *An Introduction to Bioinformatics Algorithms*, MIT Press, First Indian Reprint 2005.

**REFERENCE BOOKS**
1. Gusfields G, Algorithms *on strings, trees and sequences- Computer Science and Computational Biology*, Cambridge University Press 1997.
2. Gary Benson Roderic page (Eds), *Algorithms in Bioinformatics*, Springer International Edition, First Indian Reprint 2004.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0394** | **MOLECULAR SIMULATION OF BIOMOLECULES** | **2** | **0** | **1** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
This subject portraits the fundamentals and applications of computer aided drug designing

**INSTRUCTIONAL OBJECTIVES**
1. Fundamentals of Computer Aided Drug Designing (CADD)
2. Drug development
3. Methods and applications

**APPLICATION OF MOLECULAR MODELING IN DRUG DESIGN**
Molecular modeling in drug discovery- three dimensional pharmacophores- molecular docking- De-novo ligand designing- and structure-based methods- molecular similarity

**DRUG DISCOVERY**
Drug discovery: targets and receptors- target identification and validation- drug interactions- small molecule drugs

**DRUG DEVELOPMENT**
Pharmacodynamics- Pharmacokinetics- toxicology- animal tests- formulations and delivery systems- future perspectives

**APPLICATIONS OF CADD**
Application and methods in protein engineering- Protein design principles and examples -applications in pharmacophores mapping

**QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP (QSAR)**
Analysis of QSAR- computational approaches to chemical libraries

**LIST OF EXPERIMENTS**
1. Analysis of 2D and 3D structures of proteins
2. Homology Modeling using SPDBV
3. Model validation using What Check and Pro Check
4. Docking using DOCK or AUTODOCK or HEX

**TEXTBOOKS**
1. Andrew R. Leach, *Molecular Modelling- Principles and application*, Prentice hall, II edition, 1996. (Unit I, unit V)
2. Rick NG, *Drugs: from Discovery to Approval***,** John Wiley & sons, 2004. (Units II, III,).
3. Paul S Charifson, P*ractical Application of Computer-Aided Drug Design*, Informa Health Care, 1997.
4. Moody PCE and Wilkinson AJ, *Protein Engineering*- IRL press oxford 1990(unit IV)

**REFERENCE BOOK**
1. Thomas J. Perun, Catherine Lamb Propst, *Computer-Aided Drug Design: Methods and Applications,* Informa Health Care, 1989.

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0439** | **PERL PROGRAMMING & BIOPERL** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
PERL is one of the important programming languages for Bioinformatics

**INSTRUCTIONAL OBJECTIVES**
This subject enables the students
1. To understand the basic commands in Unix
2. Control statements in PERL

**UNIX OS AND EDITORS**
Unix OS-Working Environment- Navigating in Unix-creating and manipulating sequence files-emacs editor-Vi editor-FTP

**UNIX COMMANDS**
Advanced Unix commands-Introduction-ls-cat-more-, Advanced Unix commands-mv-rm-rmdir-uniq-sort-,Advanced Unix commands-grep.

**PERL**
Introduction to Perl-scalars, Arrays-Using standard Perl modules-Perl regular expressions I.

**PERL ARRAY OPERATIONS AND CONTROL STATEMENTS**
Perl debugger-Advanced array operation-Perl regular expression II- Perl control statements-FILE I/O- Perl subroutines and Functions.

**BIOPERL**
Installation and usage of bioperl modules

**TEXTBOOKS**
1. Harshawardhan P Bal, *Perl Programming for Bioinformatics*, Tata McGraw Hill, 2003.
2. James Tisdall, *Mastering Perl for Bioinformatics,* O'Reilly, 2003

**REFERENCE BOOKS**


1. D. Curtis Jamison, *Perl Programming for Bioinformatics & Biologists*, John Wiley & Sons, INC., 2004
2. Michael Moorhouse, Paul Barry, *Bioinformatics Biocomputing and Perl*, Wiley, 2004.


| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0441** | **PERL PROGRAMMING LABORATORY** | **0** | **0** | **3** | **1** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.

**INSTRUCTIONAL OBJECTIVES**

The student will be able to understand and develop the concept of analyzing scientific data using perl

**LIST OF EXPERIMENTS**

1. Computer Programming Lab I– Unix and Perl
2. Unix Commands
3. Working with vi, emacs editors.
4. Simple programs using Operators, Control Structures, Subroutines, Hash Traversal Functions, and Launching External Programs Special Variables.
5. Simple programs using File Functions, Special Conditionals Command Line Args; Basic I/O.
6. Setuid / setgid Perl Scripts Random Number Generation
7. Creating a static HTML file by a Perl Program

**REFERENCE BOOK**


1. Lab Manual D. Curtis Jamison, *Perl Programming for Bioinformatics & Biologists*, John Wiley & Sons, INC., 2004


**ELECTIVES OFFERED TO THE OTHER BRANCHES OF THE UNIVERSITY**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **BT0445** | **SYSTEM BIOLOGY** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

To impart knowledge on phylogenetics and phylogenomics.

**INSTRUCTIONAL OBJECTIVES**

1. To provide basic and advanced information about phylogenetics and its analysis
2. To educate the students about the methods and comparative analysis

**PHYLOGENETIC ANALYSIS AND PARSIMONY ANALYSIS**

Phylogenetics analysis - Introduction, Methods- the matrix, homology, character coding, choosing outgroups, weighting, the tree, multiple trees, tree statistics; models of causation-Parsimony analysis -Introduction, the legacy of Willi Hennig, methods, searching, parsimony analysis using Nona

**OPTIMIZATION ALIGNMENT**

Introduction, going down to get the tree length, going up to get ancestral states, short cuts and errors, improvements; Techniques for analyzing large data sets - Traditional techniques, Composite Optima, Ratchet, Sectorial searches, tree-fusing, tree-drifting, combined methods, minimum length, TNT

**PARTITIONING OF MULTIPLE DATASETS IN PHYLOGENETIC ANALYSIS**
Measures of support -The bootstrap, Jackknife, Noise, Direct measures of support-Partitioning of multiple datasets in phylogenetic analysis - Statistical tests of data incongruence, Measures of character interaction in combined analysis, congruence, incongruence and phylogenetic inference

**COMPARATIVE PHYLOGENOMICS**
Complex model organism genome databases - Database foundations, genome databases, homology and genome databases; Comparative phylogenomics - Genomics and systematics, genomics techniques – cloning and library construction, megabase DNA isolation, physical mapping, shortgun sequencing; Subgenomics –comparative maps and syntheny, Primer batteries and multiplexing.

**COMPARATIVE METHODS AND ANALYSIS**
Correlated evolution and independent contrasts, importance of topology, examining the tempo and mode of evolutionary change. Analyzing data at the population level -Sequence and Allele frequency data

**TEXT BOOK:**
1. *Techniques in molecular systematics and evolution*, Rob Desalle, Gonzalo Giribet, Ward Wheeler, Springer.

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| **BT0446** | **BIOCATALYSIS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**
To provide basic and advanced information on biocatalysis so that the students are aware of its use and potential applications in industry.

**INSTRUCTIONAL OBJECTIVES**
1. To introduce basic concepts about enzymes and its role as a catalyst
2. To instruct the students about the molecular biology tools used in biocatalysis and the methods to engineer enzyme reactions
3. To emphasize the importance of enzymes as catalysts in pharmaceutical and other industries.

**INTRODUCTION**
Characteristics of Biocatalysis – enzyme catalysis, sources and reasons for the activity of enzymes as catalysts, Performance criteria; Current penetration of biocatalysis; Isolation and preparation of microorganism – Screening of enzyme activities, strain development, extremophiles.

**MOLECULAR BIOLOGY TOOLS FOR BIOCATALYSIS**
Molecular biology basics, DNA isolation and purification, Gene isolation, detection and verification, Cloning techniques, expression of an enzyme function in a host.

**ENZYME REACTION ENGINEERING**
Kinetic modeling, Ideal kinetics and reactors, enzymes with unfavourable binding, reactor engineering, influence of immobilization, deactivation kinetics, E-value and its optimization.

**APPLICATIONS OF ENZYMES AS BULK ACTIVES**
Enzymes in – Laundry detergents, textile industry, pulp and paper industry, animal feed

**APPLICATIONS OF ENZYMES AS CATALYSTS**
Enzymes as catalysts in – processes towards basic chemicals, fine chemicals industry, food industry, towards crop protection chemicals, large scale pharma intermediates.

**TEXT BOOK:**
1.*Biocatalysis*, A.s. Bommarius and B.R. Riebel, Wiley-VCH Verlag GmbH & Co, 2004

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| **BT0447** | **PHYSICS OF PROTEIN-DNA INTERACTION** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**

To familiarize the students about the importance of multidisciplinary approach to the understanding of protein-DNA interaction from physics perspective.

**INSTRUCTIONAL OBJECTIVES**

1. To introduce the molecular aspects of cell and its contents, DNA, RNA, and proteins
2. To provide knowledge about the role of physics behind the interaction between proteins and DNA and the resulting manipulation of this interaction.

**INTRODUCTION**

Central dogma and bacterial gene expression – two families, prokaryotic gene expression; Molecular structure – chemical structure of DNA, physical structure of DNA, chemical structure of proteins, physical structure of proteins.

**PROTEINS AND DNA**

Levels of structures in proteins, internal rotation angles, Ramachandran plot, Forces stabilizing the structure of proteins and DNA, Olson-Flory plot, base-pairing and stacking.

**THERMODYNAMICS AND KINETICS OF REPRESSOR-DNA INTERACTION**

Thermodynamics and the lac repressor – the law of mass action, statistical mechanics and operator occupancy, entropy, enthalpy, lac repressor complex; kinetics of repressor-DNA interaction – reaction kinetics, Debye-Smoluchowski theory, BWH theory, indirect read-out and induced fit.

**DNA DEFORMABILITY AND PROTEIN-DNA INTERACTION**

Eukaryotic gene expression, chromatin condensation, White's theorem; Worm-like chain – circular DNA, persistence length, nucleosomes and the Marky-Manning transition, protein-DNA interaction under tension, Force –extension curves; RST model – structural sequence sensitivity, thermal fluctuations.

**ELECTROSTATICS IN WATER AND PROTEIN-DNA INTERACTION**

Macro-ions and aqueous electrostatistics , Primitive model – ion-free, DH regime; Manning condensation – charge renormalization, Oosawa theory, free energy; Counter-ion release and non-specific protein-DNA interaction – counter-ion release, nucleosome foration, isoelectric instability.

**TEXT BOOKS:**

1. *Biophysical Chemistry*, Cantor.R. Samuel.P.R., W.H.Freeman & Co.
2. *Physics of Protein-DNA Interaction*, R.F. Bruinsma, Elsevier

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| **BT0448** | **BIOTERRORISM** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**

To impart knowledge about bioterrorism and preparedness for biological warfare to various branches of the engineering so that a meaningful strategy can be evolved to tackle it.

**INSTRUCTIONAL OBJECTIVES**

The students will be provided with the knowledge about the current concepts of bioterrorism, the role of body in warding off these microbes, the various biological tools that can be used as weapons, and the important role of society and government in preventing such acts of bioterrorism.

**TERRORISM AND BIOTERRORISM**

Definition-Traditional terrorists-New terrorists-Nuclear, chemical, and radiological weapons-The psychology of bioterrorism-Historical perspective

**MICROBES AND IMMUNE SYSTEM**
Primary classes of Microbes-bacteria, virus, and other agents-Immune system-Interaction between microbes and the immune system

**BIOTERRORISM WEAPONS AND TECHNIQUES**
Characteristics of microbes and the reasons for their use-Symptoms-Pathogenecity-Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Small pox, and Tularemia and VHF

**PREVENTION AND CONTROL OF BIOTERRORISM**
Surveillance and detection- Detection equipment and sensors –Diagnosis-Treatment-Vaccinations-Supplies-Effectiveness-Liability-Public resistance-Response-First responders-Infectious control-Hospital-Prevention-Protection-Decontamination-Notification-Role of Law enforcement-Economic impact

**BIOTERRORISM MANAGEMENT**
Ethical issues: personal, national, the need to inform public without creating fear, cost-benefit rations-Information management-Government control and industry support-Microbial forensics

**TEXT BOOKS:**

1. *Bioterrorism: Guidelines for Medical and Public Health Management*, Henderson, Donald, American Medical Association, 1st Edition,2002
2. *Biological Weapons: Limiting the Threat (BCSIA Studies in International Security)*, Lederberg, Joshua (Editor), MIT Press ,1999
3. *Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century)*, I.W. Fong and Kenneth Alibek, Springer, 2005


**REFERENCE BOOKS**

1. *The Demon in the Freezer: A True Story*, Preston, Richard, Fawcett Books, 2003
2. *The Anthrax Letters: A Medical Detective Story* , Cole, Leonard A., Joseph Henry Press, 2003
3. *Biotechnology research in an age of terrorism: confronting the dual use dilemma*, National Academies of Science, 2003


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| **BT0449** | **BIOTECHNOLOGY EXPLORATIONS-APPLYING THE FUNDAMENTALS** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE:**
To educate the non-major biology students about the expanding field of biotechnology and its applications in medicine, food, agriculture, and the environment.

**INSTRUCTIONAL OBJECTIVES**
The course offers
1. An understanding of biotechnology, carefully blending science, consumer applications, regulatory information
2. A comprehensive overview of the basic science underlying the principles of biotechnology
3. An explanation of biotechnology and its significant applications

**INTRODUCTION**
Historical perspective on Science, technology, and society-Advancement of mankind due to science and its relevance in present day living conditions

**BASIC CONCEPTS ABOUT CELL**
Cell: basic unit of life-Molecular components of cell-Expression of genetic information-Protein structure and function-Cell metabolism-Cells maintain their internal environments-Cells respond to external environments-Cells grow, reproduce, and differentiate

**ORGANISMS TO ECOSYSTEMS**
Patterns of Genetic Inheritance--From Genotype to Phenotype-Evolutionary Mechanisms-Ecological Interactions

**BIOTECHNOLOGY-APPLICATIONS AND ISSUES**
Basic concepts about biotechnology-Research applications-Biotechnology toolbox-Biotechnology in the research laboratory

**COMMERCIAL APPLICATIONS OF BIOTECHNOLOGY**
Moving Science from the Laboratory into Society-Risks and Regulations -Health Care Applications -Medical Biotechnology in Society - Biotechnology in the Food Industry-Ecology and Evolution in Agriculture-Biotechnology and Sustainable Agriculture-Environmental Sustainability and Biotechnology

**TEXT BOOKS**
1. *Biology and Biotechnology: Science, Applications, and Issues*, Helen Kreuzer and Adrianne Massey, ASM Press, 2005
2. *The Cell: A molecular approach* by Geoffrey M.Cooper.ASM Press, 2007

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| **BT0450** | **BIOPROSPECTING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**
The main purpose of this subject is to create basic awareness about bioprospecting.

**INSTRUCTIONAL OBJECTIVES**
1. To introduce bioprospecting.
2. To create complete knowledge about the microbial diversity and biogeography.
3. To provide complete knowledge about the microbial prospecting.

**INTRODUCTION AND MICROBIAL DIVERSITY**
Introduction – biotechnology the art of exploring biology, Overview of microbial diversity, species concept for prokaryotic and eukaryotic microorganisms, speciation and bacterial phylospecies, approaches to identification and eukaryotic diversity.

**MICROBIAL ECOLOGY**
Culture dependent and independent microbiology, resuscitation of uncultured microorganisms, soils the metagenomic approach, deep biospheres, icy biosphere. Extremophiles – pH, temperature, salinity and pressure. Role of oligobacteria, anaerobes – sulfate reducing bacteria and microbes from marine sponges.

**BIOGEOGRAPHY, MAPPING, AND BIOINFORMATICS OF MICROBIAL DIVERSITY**
Ubiquitous dispersal of free living microorganisms, microbial endemism and biogeography and mapping microbial diversity- the Yellowstone national park microbial database and map server. The paradigm shift in microbial prospecting, genomics, bacterial proteomics, phenomics, phylogeny and functionality.

**PROSPECTING AND CONSERVATION OF MICROBIAL GENE POOLS**
Screening for bioactivity, antimicrobials, pharmacologically active agents of microbial origin, bioprospecting for industrial enzymes, plant growth promoting agents, biotreatment, bioprospecting novel antifoulants and anti-biofilm agents from microbes. Extinction and the loss of evolutionary history.

**CONVENTION ON BIOLOGICAL DIVERSITY**
The convention on biological diversity and benefic sharing, historical context of present bioprospecting, biodiversity prospecting – the INBio experiences, contracts for bioprospecting, natural products research partnerships with multiple objectives in global diversity hotspots.

**TEXT BOOK**
*Biotechnology explorations: Applying the fundamentals*, Judith A. Scheppler, Patricia E. Cassin and Rosa M. Gambier. 2000.

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| **BT0451** | **MOLECULAR FARMING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The main purpose of this subject is to create basic awareness about molecular farming

**INSTRUCTIONAL OBJECTIVES**

1. To introduce molecular farming.
2. To create complete knowledge about the recombinant protein production.
3. To create awareness about the production of pharmaceutical proteins in plants.

**INTRODUCTION AND FOREIGN PROTEIN EXPRESSION**

Introduction, foreign protein production systems- plant tissue culture, suspended cultures, hairy root cultures, shoot teratoma cultures. Strategies for improving FP production in tissue culture, expression systems, modifications to existing expression constructs, secretion of foreign proteins, foreign protein stability, stability inside the cells.

**NOVEL SPROUTING TECHNOLOGY FOR RECOMBINANT PROTEIN PRODUCTION**

Biology of sprouting, dicotyledonous seeds, germination, sprout, rubisco synthesis, rubisco promoters, inhibition of endogenous gene expression, expression cassette design, sprouting- equipments, conditions, sterilization, time and temperature, light, inhibition of endogenous gene expression, growth regulators, nitrogen fertilizer, seed production, quality and environmental aspects.

**MONOCOT AND PLANT VIRAL EXPRESSION SYSTEMS**

Cereal production crops, Technical aspects, cereal transformation, expression construct design, Prodigene and Maize. Recombinant proteins expressed in Rice, Wheat, Barley. Plant RNA viruses as expression vectors- TMV, PVX, CPMV, AIMV. Biological activity of target molecules, efficacy of plant virus antigens, vaccine antigens- particle based.

**CHLOROPLAST DERIVED ANTIBODIES, BIOPHARMACEUTICALS AND EDIBLE VACCINES**

Introduction, expression of therapeutic and human proteins in plants, transgenic chloroplast system, chloroplast derived human antibodies, biopharmaceuticals, Human Serum Albumin, Human insulin like growth factor-1, Human interferon, Antimicrobial peptides, chloroplast derived vaccine antigens, cholera toxin B subunit, *Bacillus anthracis* protective antigen, *Yersinia pestis* F1-V fusion antigen, Canine Parvovirus VP2 protein.

**DOWNSTREAM PROCESSING OF PLANT DERIVED RECOMBINANT THERAPEUTIC PROTEINS**

Similarities and differences in the processing of pharmaceutical proteins from different sources, process scale, individual steps of a Downstream process, Initial processing and extraction, chromatographic purification, regulatory requirements for downstream processing of plant derived products.

**TEXT BOOK**

*Molecular Farming – Plant-made Pharmaceuticals and Technical Proteins*, Rainer Fischer and Stefan Schillberg. Wiley.VCH Verlag GmbH and Co. KGaA. 2004.

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| **BT0452** | **BIOMINING** | **3** | **0** | **0** | **3** |
| | **Prerequisite** | | | | |
| | **Nil** | | | | |

**PURPOSE**

The main purpose of this subject is to create basic awareness about biomining

**INSTRUCTIONAL OBJECTIVES**

1. To introduce biomining.
2. To create complete knowledge about the bioleaching of copper.
3. To create awareness about geobiotics.

**COMMERCIAL APPLICATIONS OF THERMOPHILE BIOLEACHING**

Introduction, Copper processing technologies- in situ leaching, smelting, concentrate leaching, Heap and dump leaching.Thermophilic Heap bioleaching – Basic heap design and importance of heat generation, sulfur availability, microbial activity, inoculation, pH, inhibitory factors, heat retention, air-flow rate and irrigation rate.

**GEOBIOTICS GEOCOAT TECHNOLOGY**

Introduction, the GEOCOAT AND GEOLEACH technologies, complementary Geobiotics technologies, the GEOCOAT process, advantages of the GEOCOAT process, the Agnes mine GEOCOAT project, developing technologies.

**GENETIC ADAPTABILITY OF BIOMINING MICROORGANISMS TO INDUSTRIAL PROCESS**

Introduction, Biooxidation of minerals, General chemistry of mineral biooxidation, advantages of biooxidation, types of organisms, general physiology of mineral-degrading bacteria, autotrophy, nitrogen, phosphate and trace elements. Energy production- iron, sulfur oxidation, adaptability of biomining microorganisms, metal tolerance and resistance.

**DETECTING AND IDENTIFYING ACIDOPHILIC MICROORGANISMS**

Biodiversity of acidophilic microorganisms, techniques for detecting and quantifying microbial life in mineral-oxidizing environments, cultivation dependent approaches, PCR based microbial identification and community analysis, PCR independent molecular detection and identification of acidophiles, future perspectives on molecular techniques for detection and identification of acidophiles.

**DOWNSTREAM PROCESSING OF PLANT DERIVED RECOMBINANT THERAPEUTIC PROTEINS**

Introduction, relevant biochemical and chemical reactions, Genetics of bioleaching microorganisms, Iron and sulfur oxidation and reduction in A*cidithiobacillus ferrooxidans*, sulfur oxidation, ferric iron and sulfur reduction in *Acidiothiobacillus ferrooxidans*. Iron oxidation in other bioleaching microorganisms – Ferroplasma spp., Leptospirillum spp, Metallosphaera sedula, sulfur oxidation in other bioleaching microorganisms.