DPU

Dr. D. Y. PATIL VIDYAPEETH, PUNE

(DEEMED UNIVERSITY)

# SYLLABUS

# FOR

# M. TECH (INTEGRATED)

# BIOTECHNOLOGY

**2014-15**

# COURSE STRUCTURE FOR M. TECH (INTEGRATED) BIOTECHNOLOGY

| SEMESTER I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 101 | Physics | 3 | 0 | 2 | 5 | 4 | 150 |
| BS 102 | Organic chemistry | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 103 | Mathematics | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 101 | Introduction to Electronics & Instrumentation Engineering | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 101 | Introduction to Computers & Computer Organization | 3 | 0 | 4 | 7 | 5 | 200 |
| HU 101 | Communication Skills | 1 | 2 | 0 | 3 | 3 | 100 |
| HU 102 | Disaster Management | 2 | 0 | 0 | 2 | 2 | 100 |
| **Total** | | **18** | **3** | **12** | **33** | **27** | **1000** |
| **BS - Basic Sciences, HU - Humanity, BT - Biotechnology, BI - Bioinformatics** | | | | | | | |
| **SEMESTER II** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 201 | Physical Chemistry | 3 | 1 | 0 | 4 | 4 | 100 |
| BS 202 | Introduction to Bio-molecules | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 203 | Biostatistics | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 201 | Engineering Mechanics | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 201 | C Programming | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 204 | Environmental Sciences | 3 | 0 | 2 | 5 | 4 | 150 |
| **Total** | | **18** | **2** | **12** | **32** | **26** | **900** |
| **SEMESTER III** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 301 | Analytical Techniques | 3 | 0 | 4 | 7 | 5 | 200 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BS 302 | Cell Biology | 3 | 0 | 2 | 5 | 4 | 150 |
| BS 303 | Microbiology | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 304 | Genetics | 3 | 1 | 2 | 6 | 5 | 150 |
| BS 305 | Mammalian Physiology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 301 | Plant Physiology | 3 | 1 | 0 | 4 | 4 | 100 |
| **Total** | | **18** | **3** | **12** | **33** | **27** | **900** |
| **SEMESTER IV** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 401 | Molecular Biology-I | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 402 | Metabolism | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 403 | Animal Tissue Cultures | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 404 | Plant Tissue Culture | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 405 | Immunology | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 301 | Concepts in Bioinformatics | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **4** | **14** | **33** | **26** | **950** |
| **SEMESTER V** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 501 | Molecular Biology-II | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 502 | rDNA Technology | 3 | 1 | 0 | 4 | 4 | **100** |
| BT 302 | Enzymology & Enzyme Technology | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 503 | Basic Pharmacology and Toxicology | 3 | 1 | 0 | 4 | 4 | **100** |
| BT 504 | Fermentation Technology | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 506 / BT 507 | Elective-I | 3 | 0 | 4 | 7 | 5 | **200** |
| **Total** | | **18** | **2** | **16** | **36** | **28** | **1000** |
| **Elective I (BT 506 : Food Biotechnology / BT 507 : Environmental Biotechnology)** | | | | | | | |
| **SEMESTER VI** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 601 | Virology | 3 | 1 | 0 | 4 | 4 | 100 |
| HU 601 | Principles of | 3 | 0 | 0 | 3 | 3 | 100 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Managements & Entrepreneurial Development | | | | | | |
| BI 605 | Introduction to Molecular Modeling and Chemo informatics | 3 | 0 | 4 | 7 | 5 | 200 |
| HU 602 | Bio safety and Bioethics & IPR | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 602 | Genomics | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 504 / BI 606 / BI 603 | Elective-II | 3 | 1 | 2 | 6 | 5 | 150 |
| **Total** | | **18** | **3** | **8** | **29** | **25** | **800** |
| **Elective II (BI 504: Operating System / BI 603:Perl & Bioperl / BI 606:Computer Networking)** | | | | | | | |
| **SEMESTER VII** | | | | | | | |
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 701 | Biomembrane and Molecular Cell Signaling | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 705 | Developmental Biology and Stem cells | 3 | 1 | 0 | 4 | 4 | 100 |
| HU 701 | Quality Control Management in Biotechnology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 706 | Transcriptomics | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 603 | Biochemical Engineering | 3 | 1 | 4 | 8 | 3 | 200 |
| BT 707 / BT 708 / BT 709 / BT 710 | Elective-III | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **3** | **8** | **27** | **25** | **900** |
| **Elective III (BT 707: Metabolic Engineering / BT 708 : Marine Biotechnology / BT 709 : Agricultural Biotechnology)** | | | | | | | |

| SEMESTER VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 801 | Protein Modeling and Drug Designing | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 802 | Proteomics | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 505 | Biomedical Engineering | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 803 | Nanobiotechnology | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 804 | Seminars in Biotechnology & Advances in Biotechnology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 805 / BT 710 | Elective – IV | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **2** | **12** | **32** | **26** | **900** |
| **Elective III (BT 805: Clinical Research / BT 710 : Biopharmaceuticals)** | | | | | | | |
| **Semester IX & X** | | | | | | | |
| | **Research Project (10 months)** | **50 Credits** | | | | **800** | |

# COURSE STRUCTURE FOR M. TECH (INTEGRATED) BIOTECHNOLOGY

| SEMESTER I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 101 | Physics | 3 | 0 | 2 | 5 | 4 | 150 |
| BS 102 | Organic chemistry | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 103 | Mathematics | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 101 | Introduction to Electronics & Instrumentation Engineering | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 101 | Introduction to Computers & Computer Organization | 3 | 0 | 4 | 7 | 5 | 200 |
| HU 101 | Communication Skills | 1 | 2 | 0 | 3 | 3 | 100 |
| HU 102 | Disaster Management | 2 | 0 | 0 | 2 | 2 | 100 |
| **Total** | | **18** | **3** | **12** | **33** | **27** | **1000** |
| **BS - Basic Sciences, HU - Humanity, BT - Biotechnology, BI - Bioinformatics** | | | | | | | |

**TITLE OF THE COURSE: PHYSICS**

| **COURSE CODE: BS-101** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 150** | **3** | **0** | **2** | **5** | **4** |

**OBJECTIVE**

The objective of this course is:

- To create general understanding regarding basic physical principles involved in living systems.
- To familiarize the student with basic concepts in physics as: classical optics used in microscopes and telescopes, thermometry and heat, mechanical, fluid and solid state properties.
- To familiarize students with concepts in digital electronics, lasers, sound waves, electricity.
- To introduce them to concepts in modern physics such as: production of X-ray, X-ray crystallography, quantum mechanics etc.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in classical and modern physics, laser sources, concepts and laws applicable to quantum-mechanical particles. This would enable him to understand use of physical methods in understanding Biomolecular structure and interactions

**PREREQUISITES**

This is an introductory course. School level knowledge of physics is sufficient. There are no prerequisites.

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Optics: Interference Diffraction & Polarization | Introduction to optics, Principles of superposition, Constructuve & destructive Interference, Types of Interference, Newton's rings. Diffraction- Types of diffraction, Diffraction grating, Rayleigh's criterion, Resolving power of Microscope and Telescope. Polarization of light waves, Polaroid, Optical activity. | 08 |
| 2 | Thermometry and Heat | Principles of Thermometry, Temperature and it's measurements, Platinum resistance Thermometer, Thermocouple and Thermistors, Modes of Heat Transfer. | 05 |
| 3 | Properties of Fluid: Surface Tension & Viscosity | Surface Tension, Surface Energy, Angle of Contact, Capillarity action, Determination of Surface tension by capillary rise method, Jaeger's method, Temperature dependence of surface tension and its applications. Viscosity, Coefficient of viscosity, streamline and | 07 |

| | | | |
|---|---|---|---|
| | | turbulent flow, Reynold's number, Stoke's law, Terminal velocity, Determination of 'η' by falling sphere method. | |
| 4 | Elasticity | Stress and Strain, Hook's law, Stress-strain curve, Young's modulus, Determination of Young's modulus. | 03 |
| 5 | Solids and Semiconductor Devices | Classification of Solids (Conductor, Semiconductor and Insulators), intrinsic and extrinsic semiconductors, PN Junction Diode, Zener Diode, Junction Transistors (CE,CB mode) | 05 |
| 6 | Introduction to Digital Electronics | Introduction to Binary mathematics, BCD numbers, Basic logic gates, De-Morgan's Theorem | 02 |
| 7 | Lasers | Properties of Lasers, Production mechanism, Ruby Laser, Helium Neon Laser, applications of Lasers. | 03 |
| 8 | Sound waves | Types of sound waves (Longitudinal and Transverse), Audible, Ultrasonic and Infrasonic waves, Beats, Doppler effect, Applications of Ultrasonic waves. | 03 |
| 9 | Electricity | Heating effect of electric current, Joule's law, Transformers, Types of Transformers. | 02 |

| | | | |
|---|---|---|---|
| 10 | Modern Physics: X-rays, Crystallography, Introduction to Quantum Mechanics | Introduction to X-Rays : Introduction, Production of X-rays, X-Ray diffraction and its Applications.<br>Introduction to crystal structure, Unit cell, seven crystal systems.<br>Plank's Quantum Theory, Properties of Photon, Photoelectric effect, wave particle duality of radiation, de Broglie's hypothesis, Heisenberg's Uncertainty principle. | 07 |
| **Total Lectures** | | | **45** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Physics-David Haliday and Robert Resnik (Vol I and Vol II) [Wiley Eastern Pub]
- Perspectives of Modern Physics-Arthur Beiser [Mc Graw Hill]
- Fundamensls of optics-Jenkins [Mc Graw Hill]
- Optics –Ajoy Ghatak [Tata Mc Graw Hill]
- Digital Principles and Applications-Malvina and Leach [Mc Graw Hill]

**PRACTICAL IN PHYSICS (TWO HOURS PER WEEK)**

**Marks 50**

The course will also have a practical component. The practical training would be in the area of optics, electronics, thermometry, calorimetry, conductivity, measurement of physical properties as: viscosity and surface tension.

**LIST OF EXPERIMENTS**

1. Diffraction Grating: Use of diffraction grafting for determination of wavelength of spectral lining.

2. Resolving Power: To determine the resolving power of Microscope or telescope.

3. Diode Characteristics: Study of forward and reverse characteristics of Diode.

   Transistor Characteristics: Study of characteristics of Photocell.

4. Band gap of semiconductor: Study of input and output characteristics of a transistor and determination of band gap of a semiconductor.

5. Ultrasonic Interferometer: Determination of velocity of ultrasonic waves by ultrasonic

6. Study of logic gates (OR, AND, NOT).

7. Thermocouple: Study of variation of thermo emf (electromotive force) with temperature.

8. Surface Tension: Determination of the surface tension of a given solution.

11. Viscosity: Determination the coefficient of viscosity by Stoke's method and its practical application.

12. Joule's Law: Determine of Joule's constant.

13. Determination of wavelength of monochromatic light by Newton's rings experiments.

14. Thermal Conductivity: Determination of coefficient of thermal conductivity of given specimen.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 10 |
| Major test at the end of semester | 3 hours | 25 |
| **Total** | | **50** |

**TITLE OF THE COURSE: ORGANIC CHEMISTRY**

| **COURSE CODE: BS 102** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 200** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is:

- To familiarize the students with basic concepts of organic chemistry.
- To familiarize the students with structures of organic molecules as: alkanes, alkenes, alkynes, aliphatic and aromatic molecules
- To introduce them to interactions amongst organic compounds

**LEARNING OUTCOME:**

At the end of this course student should be able to understand basic principles of organic chemistry and develop skills in handling organic molecules. This is essential for undertaking practical training in Biochemistry and genetic engineering at the later stage.

**PREREQUISITES:**

This is an introductory course. There are no prerequisites for the course.

**COURSE DESCRIPTION**

| **Sr. No** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Introduction to organic chemistry | Functional groups | 2 |
| 2 | Organic compounds | Chemistry of alkanes, alkenes, alkynes (Comparative study) | 5 |
| 3 | Stereochemistry | Stereo isomers, Enantiomers, Chiral centers/ Optical activity, Geometric isomers<br>Meso- isomers, Conformational isomers | 8 |

| | | | |
|---|---|---|---|
| 4 | Chemistry of cyclic aliphatic carbons | Nomenclature and preparation, Reactions of small ring compounds, (cyclopropane and cyclobutane), Baeyers Strength Theory, Stereochemistry of Cyclic Aliphatic compounds | 8 |
| 5 | Chemistry of heterocyclic compounds | Furan, Pyrrole, Thiophene, Purines, Pyrmidines (Nucleic acids), Quinoline, Isoquinoline | 8 |
| 6 | Chemistry of aromatic compounds | Structure of Aromatic compounds (Benzene and its derivatives), Aromatic Characters: The Huckel rule ( 4N+2) | 8 |
| 7 | Reaction mechanisms | Nucleophilic $SN_1$, $SN_2$ , Electrophilic $E_1$ and $E_2$ ) | 5 |
| **Total Number of lectures** | | | **44** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Organic Chemistry ($6^{th}$ Edition, 1992)- Robert Thornton Morrison and Robert Neilson Boyd (Prentice Hall)
- Organic Chemistry Vol. I and II and III by I. L Finnar. $5^{th}$ Edition Pearson Publications

**PRACTICAL IN ORGANIC CHEMISTRY (4 Hrs. PER WEEK)**

**MARKS 100**

**LIST OF EXPERIMENTS:**

1. 10 Quantitative analysis, 5 organic and inorganic mixtures
2. Quantitative analysis:
    - Estimation of aniline, acetone, and aspirin
    - Molecular weight of monobasic/dibasic acids.
3. Preparation of orange dyestuff (Sagand III)
4. Preparation of p-nitroacetanilide from actanilide
5. Preparation of acetnilide from aniline
6. Preparation 2,4 DNP derivatives
7. Estimation of $Cu^{2+}$ from brass
8. Estimation of %q of $NH_4Cl+BaSO_4$ grarimetric analysis
9. Preparation of Std. $K_2Cr_2O_7$ solution and estimation of Fe (II) and Fe(III) from a given mixture of Fe(II) and Fe(III) using external indicators.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 20 |
| Major test at the end of semester | 3 hours | 50 |
| **Total** | | **100** |

**TITLE OF THE COURSE: MATHEMATICS**

| **COURSE CODE: BS-103** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **0** | **4** | **4** |

**OBJECTIVE**

The objective of the course is to familiarize the student with basic concepts in mathematics.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient understanding of different mathematics and statistical tools used in Biotechnology. This knowledge would be applicable in different industries

**PREREQUISITES**

Students should be familiar with school level mathematics to take up this course. In case they do not have mathematics at the 10+2 level they should have cleared the core mathematics in the first semester.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Lectures Required** |
|---|---|---|
| 1 | Algebra :<br>1.1 Logarithms<br>1.1.1 Definition of Logarithm (Natural and common logarithm<br>1.1.2 Laws of Logarithm. | 02 |
| | 1.2 Binomial Theorem:<br>1.2.1 Definition of factorial notation, peronntation & combinations.<br>1.2.2 Binomial Theorem for positive index.<br>1.2.3 General term, middle term<br>1.2.4 Binomial theorem for any index<br>1.2.5 Binomial Theorem for Approximation. | 04 |
| 2 | Trigonometry :<br>2.1 Trigonometric Rations (t-ratios) | 03 |

| | | |
|---|---|---|
| | 2.1.1 t-ratios of any angle, Relation between t-ratios, Fundamental identities.<br>2.1.2 Relation between degree & radian, T-ratios of std. angles.<br>2.1.3 Quadrants sign of T-ratios in various quadrants, T-ratios of negative angles. | |
| | 2.2 T-ratios of Allied, Compound, Multiple and Submultiples angles.<br>2.2.1 T-ratios of Allied angles.<br>2.2.2 T-ratios compound angles.<br>2.2.3 T-ratios of multiple & sub-multiple angles.<br>2.2.4 Factorization formulae<br>2.2.5 Defactorization formulae. | 08 |
| | 2.3 Inverse Trigonometric Functions.<br>2.3.1 Definition of Inverse t-functions.<br>2.3.2 Principle value of inverse t-functions. | 02 |
| 3 | Function and Limit<br>3.1 Function :<br>3.1.1 Definitions of variable, constant, intervals such as open, closed, semi-open etc.<br>3.1.2 Definitions of function, value of function, domain & range of a function. | 02 |
| | 3.2 Limits :<br>3.2.1 Concepts and definition of Limit.<br>3.2.2 Limits of algebraic functions.<br>3.2.3 Limits of trigonometric functions.<br>3.2.4 Limits of exponential functions.<br>3.2.5 Limits of logarithmic function. | 06 |
| 4 | Derivatives<br>4.1 Derivatives :<br>4.1.1 Definition of Derivatives, notations.<br>4.1.2 Rules of Derivatives (without proof)<br>4.1.3 Derivatives of composite functions.<br>4.1.4 Derivatives of Inverse trigonometric function by substitution method.<br>4.1.5 Derivatives of Implicit functions.<br>4.1.6 Logarithmic differentiation.<br>4.1.7 Second order differentiation. | 06 |
| | 4.2 Application of Derivatives | 04 |

| | | |
|---|---|---|
| | 4.2.1 Geometrical meaning of the derivatives.<br>4.2.2 Equations of Tangent & normal to the given curve.<br>4.2.3 Maxima & Minima. | |
| 5 | 5.1. Integration :<br>5.1.1 Definition of integration, Integration of Standard function; Rules of Integration.<br>5.1.2 Integration of rationale functions; Trigonometric functions to determine constant of Integration, | 03 |
| | 5.2. Definite Integration:<br>5.2.1 Definition of Definite integral, definite.<br>5.2.2 Definite integral with simple problems. | 02 |
| | 5.3. Application of Definite Integrals<br>5.3.1 Area under the curves.<br>5.3.2 Area between two curves. | 02 |
| 6 | Differential Equation (D.E.) | 04 |
| | 6.1. Definition of D.E., order & degree of D.E., formation of D.E for function containing single constant. | |
| | 6.2 Solution of D.E. of first order & first degree such as:<br>i) Variable separable type.<br>ii) reducible to variable separable form<br>iii) Exact D.E.<br>iv) Linear D.E<br>v) Bernoulli's D.E. | |
| Total Lectures | | 48 |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials. In tutorials difficulties would be solved. Problems would be given. Students would be given assignments in the form of questions. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


- Mathematics for Biological Science by Jagdish Arya & Ladner.1979. Prentice Hall
- Numerical methods by E. Balguruswamy. 1999. Tata Mc Graw Hill Publications Pvt Ltd.
- Higher Engineering Mathematics B. S. Grewal, Khana Publication, New Delhi. 2003
- Applied Mathematics P. N. Wartikar, Pune Vidaypeeth, Griha Prakashan, Pune
- Introductory Methods of Numerical analysis, S. S. Sastry, Prentice Hall of India, New Delhi.2005.

**TITLE OF THE COURSE: INTRODUCTION TO ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| **COURSE CODE: BT 101** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **2** | **5** | **4** |

**OBJECTIVE OF THE COURSE:**

Objective of the course is to familiarize students with the basic concepts of electronic engineering and electronics engineering.

This knowledge would help them in applying them in various biological techniques. Also the Knowledge of this subject will form a profound base for the instrumentation used in various advanced courses of Biotechnology and Bioinformatics.

**LEARNING OUTCOME**

At the end of this course student should be able to understand the engineering electronics and instruments.

**PREREQUISITES**

Since the course is very basic in nature, knowledge of physics and mathematics is required

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| | **Electronics** | | |
| 1 | Introduction to Electronics | History and Scope of Electronics | 1 |
| 2 | Electronic Signals | Characteristics of electrical Signals | 2 |
| 3 | Electronic devices | Input & output relations, Simple electronics devices: Resistors, Capacitors, Inductors, Bias voltage. | 6 |

| | | | |
|---|---|---|---|
| 4 | Electronic circuits | Simple circuits for amplification, power supplies and for wave shaping .Amplification: Concept of amplification, type of amplifiers, OP-Amp and its characteristics, simple applications (Adder, substracter, integrator, differentiator), and filters. | 8 |
| 5 | Digital electronics | Number systems, binary codes, Boolean algebra, arithmetic operations, logic functions, combinational and sequential logic, different OR, AND, NOR, NAND, EXOR gates, flip flops, registers and counters. | 8 |
| 6 | Microprocess or | Introduction to Microcomputer and Microprocessor and block diagram, CPU and ALU, Timing and control unit and Block diagrams instruction and data formats. | 4 |
| 7 | Interfacing peripherals and applications | A to D converters, DAC, Resolution, speed, types | 4 |
| | **Instrumentation** | | |
| 1 | Introduction | Introduction to instrumentation and definitions | 1 |
| 2 | Sensing elements | Types of sensors, electrodes and transducers | 1 |
| 3 | Electrodes: | Electrolyte interface, Sensing elements, Detectors, Signal conducting circuits, circuit models, suitability of electrode potentials, circuit models, external and internal electrodes, pH, pO2 and pcO2 electrodes, connectivity. | 4 |

| | | | |
|---|---|---|---|
| 4 | Transducers | Definitions, types, displacement pressure, temperature, vibration, ultrasound etc, calibration, sensitivity and resolution, Flow transducers & Rota meter, venturi, orifice Plate | 6 |
| | **Total Number of Lectures** | | **45** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Digital Electronics by R. K. Jain Jain, Tata Mc Graw Hill, 3rd Edition, 2003.
2. Grob's Basic Electronics – Mitchel E. Schultz.., Tata McGraw Hill, 10th Edition 2006.
3. Principals of electronics By V. K. Mehta , S. Chand Publisher , 1st Edition , 2010.
4. Op Amps and linear integrated circuits By Ramakant Gaikwad, McGraw –Hill publishing company limited, 4th Edition, 2002.
5. Integrated Electronics By Millman and Halkias. Mcgraw-Hill, 3rd Edition 1972 .
6. The Z 80 Microprocessor By Ramesh Gaonkar,. Penram Publisher , 3rd Edition, 1988.
7. A course in electrical and electronic measurements and instrumentation by A. K. Sawhney, Puneet Sawhney, Rai publisher, 1996.

**PRACTICALS IN BASIC CONCEPTS IN ELECTRONICS AND INSTRUMENTATION ENGINEERING (2 Hrs. PER WEEK)**

**MARKS 50**

**COURSE DESCRIPTION**

| Sr. No. | Name of the Practical | Time (Hrs.) |
|---|---|---|
| 1. | Study of diode characteristics | 4 |
| 2. | Study of operational Amplification 741 i) Inverting Amplifier ii) Non inverting amplifier | 4 |
| 3. | Study of operational Amplification 741 i) Inverting Amplifier ii) Non inverting amplifier | 4 |
| 4. | Study of Ph meter circuits & working | 4 |
| 5. | Study of Ph electrodes & role of electrolytes | 4 |
| 6. | Study of Conductivity meter, circuits & working | 4 |
| 7. | Study of Conductivity meter electrodes & functions | 4 |
| 8. | Pressure development & vibration DVPT | 4 |

**EVALUATION SCHEME PRACTICAL TRAINING**

| Examination | Duration | Marks |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| Major test at the end of semester | 2.5 hours | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: INTRODUCTION TO COMPUTERS AND COMPUTER ORGANIZATION**

| **COURSE CODE: BI 101** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 150** | **3** | **1** | **2** | **6** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is

- To familiarize the students with computers and programming concepts.
- To introduce basic concepts in: hardware, software and its implementation.
- To introduce concepts of Networking, World Wide Web (Internet), Telnet, FTP, Etc.
- Programming module is intended to familiarize them with computer logic and solution of real world problems using computers.
-

**LEARNING OUTCOME**

At the end of this course student would be able to understand basic principles of Computing, Networking and Programming.

**PREREQUISITES**

The course is of introductory nature and there are no prerequisites for the course.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Basic Organization of Computers | Introduction to Computer, historical background, Block diagram of a Computer, parts of Computer, their integration and function . | 3 |

| | | | |
|---|---|---|---|
| 2 | Hardware | Computer hardware, different types of I/O devices, motherboard, BIOS, Primary and Secondary Memory, different types of Printers, Storage Media, their sizes and use. Computer booting, loading operating system (OS) and execution. execution cycle (fetch and execute) | 5 |
| 3 | Software | Introduction to software, Application software (Packaged & Customized) and System Software (OS & Utilities). Complier & Interpreter, software loading and execution, Task management by OS for Application Software. | 4 |
| 4 | Types of Computer | Difference between Super Computer, Mini Computer and a Micro Computer and their applications. | 2 |
| 5 | Data representation in Computers | Introduction to Binary, Octal and Hexadecimal Number System | 2 |
| 6 | Binary Arithmetic | Basic Binary Arithmetic i.e. Addition, Subtraction, Multiplication, Division, Compliments, Subtraction by means of 2's Compliment, Logical operations on Binary (AND, OR, NOT) | 4 |
| 7 | Transforming Data into Information | Distinction between data and information their represented in computers. | 1 |
| 8 | Operating System & Interface | OS, tasks performed by OS , Introduction to DOS, Windows and Linux/UNIX | 2 |
| 9 | Networking Fundamentals | Computer networks (n/w), various terms associated with | 5 |

| | | | |
|---|---|---|---|
| | | networks, topologies for n/w, different mediums, hardware and technologies associated with n/w, n/w protocols, introduction OSI layers, TCP/IP stack, services provided by TCP, IP Addressing | |
| 10 | Client Server Architecture | Introduction to client, server, client-server architecture | 1 |
| 11 | LAN/WAN/ MAN/CAN | Introduction to LAN/WAN/MAN and CAN, and their use. Different technologies used to implement them. | 2 |
| 12 | Telnet, FTP | History and use of Telnet based on UNIX terminals. FTP and its use. TFTP. Case study how to setup Telnet and FTP servers on LINUX | 3 |
| 13 | Internet, WWW, HTML | Internet, DNS and name resolution. History of Internet. IP Addressing scheme and its relation to the Internet. Basic HTML tags | 4 |
| 14 | Introduction to C and Programming in high level language | Data types, Decision control, Loop control, Case control, Functions, Arrays and Strings | 8 |
| **Total Number of Lectures** | | | **46** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Introduction to Computers by Norton
- Fundamentals of Computers by Raja Raman
- Computers Fundamentals by Sinha
- Introduction to Computers by Subramanian.

**TITLE OF THE COURSE: COMMUNICATION SKILLS**

| **COURSE CODE: HU-101** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **1** | **2** | **0** | **0** | **0** |

**OBJECTIVE:**

The objective of this course is:

- To develop communication skills amongst students,
- To familiarize students with communication elements,
- To acquaint them with the Scientific reading , Writing & Presentation skills.
- To familiarize students with concepts in plagiarism.

**LEARNING OUTCOME:**

At the end of the course, the students will be able to use different forms of communication, produce good document in science and avoid plagiarism of any form.

**PREREQUISITES:**

This is an introductory course and there are no prerequisites.

**COURSE DESCRIPTION :**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of Lectures** |
|---|---|---|---|
| 1 | Introduction to communication | Elements, definitions, scope of communication and communication as part of science | 02 |
| 2 | Communication elements | Verbal and nonverbal communications. Principles of effective communication, Oral presentations, Barriers to | 02 |

| | | | |
|---|---|---|---|
| | | communications, Use of good English: Introduction to English Grammar: parts of speech, use of articles & prepositions, use of correct tense, spellings etc. | |
| 3 | Scientific reading, writing & presentation | Introduction to scientific reports and writings? Compilation of experimental data, Communication methods in science, Use of good English in science, Examples of Scientific and Unscientific writing. Process of Scientific writing: thinking, planning, rough drafts and revising context. Different styles of scientific writing APA, MLA or Chicago. Writing papers, reviews and Bibliography | 08 |
| 4 | Plagiarism | Introduction to Plagiarism Examples of Plagiarism | 04 |
| **Total Lectures** | | | **16** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials. During tutorials, students would be made to present scientific and nonscientific data/information using different communication skills. They would be corrected as and when needed and taught how to improve their skills in reading, writing and data presentation.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Technical Writing and Professional Communication- Thomas Huckin and Lesle Oleson London William Collins and Sons.
- Business English and Communication- By Lyn Clark and Zimmer. New York Mcgraw Hill.
- Developing Communications-Mohan K

**TITLE OF THE COURSE: DISASTER MANAGEMENT**

| **COURSE CODE: HU-101** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **2** | **0** | **0** | **2** | **2** |

**LEARNING OBJECTIVE:**

- To provide student an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional process in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**COURSE DESCRIPTION :**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of Lectures** |
|---|---|---|---|
| 1 | Introduction to Disasters | Concepts and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks) | 04 |
| 2 | Disasters: Clarification, Causes, Impacts (Including social, economic, political, environmental, health, psychosocial, etc.) | Differential impacts – in terms of caste, class, gender, age, location, disability, Global trends in disasters urban disasters, pandemics, complex emergencies, Climate Change | 08 |
| 3 | Approaches to Disasters Risk | Phases, Culture of safety, prevention, mitigation and | 08 |

| | | | |
|---|---|---|---|
| | reduction | preparedness, community based DRR, Structural – nonstructural measures, roles and responsibilities of community, Panchayati Raj Institution / Urban Local Bodies (PRIs/ULBs), states, centre and other Satke-holders | |
| 4 | Inter-relationship between Disasters and Development | Factor affecting Vulnerabilities, differential impacts, impact of Development project such as dams, embankments, changes in Land-ude etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources | 04 |
| 5 | Disaster Risk in India | Hazard and Vulnerability profile of India Components of Disaster Relief : Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional Arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, Plans, programmes and legislation) | 06 |
| 6 | Project Work | Field Work, Case Studies | 06 |
| Total Lectures | | | 36 |

**METHODOLOGY**

The course will be covered through lectures& classroom discussion.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Alexander David, Introduction in "Confronting Catastrophe', Oxford University Press, 2000.
2. Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Science working Paper no. 8, 2008
3. Blaikie, P, Cannon T, Davis I, Wisner B 1997, At Risk Natural Hazards, Peoples, Vulnerability and Disasters, Rutledge.
4. Coppola P Damon, 2007, Introduction to International Disaster Management,
5. Carter, Nick 1991, Disaster Management : A Disaster Manager's Handbook, Asian Development Bank, Manila Philippines.
6. Cuny, F.1983, Development and Disasters, Oxford University Press
7. Document on World Summit on Sustainable Development 2012
8. Govt. of India : Disasters Management Act 2005. Government of India, New Delhi
9. Government of India, 2009, National Disasters Management Policy.

10. Gupta Anil K, Sreeja S. Nair, 2011, Environmental Knowledge for Disasters Risk Management, NIDM, New Delhi
11. Indian Journal of Social Work 2002, Special Issue on Psychosocial Aspects of Disasters, Vol. 63, Issue 2, April
12. Kapur, Any & Other 2005 : Disasters in India Studies of Grim reality, Rawat Publishers, Jaipur

| SEMESTER II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 201 | Physical Chemistry | 3 | 1 | 0 | 4 | 4 | 100 |
| BS 202 | Introduction to Bio-molecules | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 203 | Biostatistics | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 201 | Engineering Mechanics | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 201 | C Programming | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 204 | Environmental Sciences | 3 | 0 | 2 | 5 | 4 | 150 |
| **Total** | | **18** | **2** | **12** | **32** | **26** | **900** |

**TITLE OF THE COURSE: PHYSICAL CHEMISTRY**

| **COURSE CODE: BS-201** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **0** | **4** | **4** |

**OBJECTIVE**

- The objective of this course is to familiarize the student with the concepts and physical principles involved in Biotechnology.
- They would learn topics such as: Basic concepts and principles of Osmosis, Dialysis, Viscosity, Colloids, Phase rule, Acid-bases, Photochemistry etc.
- They would be made to understand the nature of Chemical Bonding, Atomic orbitals and Bioenergetics its relevance in stabilization of the molecules.
- They would also learn Basic principles of radioactive isotopes.

**LEARNING OUTCOME**

At the end of the course, the students will be able to use different Biophysical techniques and principles used in Biotechnology.

**PREREQUISITES**

This is the first introductory course and there are no prerequisites.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of Lectures** |
|---|---|---|---|
| 1 | Basic concepts and principles | 1. Osmosis- Diffusion, Osmotic Pressure, Theories of Osmosis.<br>2. Dialysis-Introduction, Technique, reverse dialysis, Glass fiber dialysis.<br>3. Viscosity –Introduction & Types of viscometer.<br>4. Colloids-Lyophilic & Lyophobic sols, Optical | 2<br>2<br>2<br>3<br>3<br>5<br>3 |

| | | | |
|---|---|---|---|
| | | properties, Electrical properties of sols, Gold number. Donnan Equilibrium.<br>5. Phase rule-Phase, Components & Degree of freedom .Derivation of Phase rule. Phase diagram. Water system.<br>6. Acid-bases- Three concepts of acids & bases, $P^H$ meter & types of electrodes ,Buffer solution, Acid base indicator , Law of mass action, Numerical.<br>7. Photochemistry – Photochemical reactions, Light absorption, Laws of photochemistry, Photo physical processes, Einstein equation. | |
| 2 | Chemical bonds and their roles in stabilizing the bio-molecules | 1. Chemical Bonding- Different types of bonds & bond characteristics Ionic Bond, Covalent bond, coordinate covalent bond, Metallic bond.<br>2. Atomic orbital's-Atomic orbital theory, Hybrid orbital's (sp, sp2, sp3), molecular orbital theory.<br>3. Bioenergetics- First & Second laws of Thermodynamics, Internal energy, Enthalpy, Entropy, concept of free energy, Standard free energy change of a chemical reaction, ATP & high | 3<br>3<br>7 |

| | | | |
|---|---|---|---|
| | | energy phosphates compounds. Chemical equilibrium constant, Nernst equation. | |
| 3 | Basic principles of radioactive isotopes | 1. Isotopes in Biology-Properties, Half-life, Radioactive decay, production of isotopes, synthesis of labeled compounds, Interaction of radioactivity with matter.<br>2. Measurement of radioactivity-Methods based on Gas ionization (Ionization chamber, Proportional counter, Geiger counter), Photographic methods, Methods based on Excitation (Liquid & solid Scintillation counting), Quenching.<br>3. Tracer technique-Advantages & limitations, Labeling procedures.<br>4. Use of Isotopes-Tritium, Carbon-13, Nitrogen-15,Oxygen -18,Carbon-14, Sodium-24, Phosphorus-32, Sulphur-35. | 4<br><br><br><br>6<br>3<br><br>2 |
| **Total lectures** | | | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials. In tutorials, students would be made to analyze data related to different Biophysical techniques. They would be also made to compute molecular properties based on bonds.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


- Physical Chemistry by Atkins Peter and Paula Julio De 7th ed.2010 Oxford University Press New Delhi.
- Principles of Physical Chemistry by David Frifelder. Jones & Bartlett Publishers; 2nd Sub edition (1984).
- Essentials of Physical Chemistry B.S. Bahl & Arun Tuli. S Chand & Co. 2000.
- Biophysical Chemistry by Avinash Upadhyay, Kakoli Upadhyay & Niamalendu Nath. Himalayan Publishing House. 2005.

**COURSE NAME: INTRODUCTION TO BIO MOLECULES**
**COURSE CODE: BS 202**
**L T P Hr Cr**
**MARKS: 200**
**3 0 4 7 5**

**OBJECTIVE OF THE COURSE:**

- The objective of the course is to familiarize the students with the basic concepts regarding chemical structure (2D-structure), three dimensional (3-D) structures and functions of Biomolecules: carbohydrates, lipids, proteins and nucleic acids.
- This knowledge would enable them to understand structure function relationship.
- Knowledge of this subject will form a profound base of forthcoming subjects like metabolism, Enzymology, molecular biology etc.

**LEARNING OUTCOME**

At the end of this course student should be able to understand structural features of Biomolecules and their relationship to their interactions.

**PREREQUISITES**

Since the course is very basic in nature there are no prerequisites.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction to bio-molecules | Functional groups, 3D (three dimensional) structure, geometric and stereo-specificity. | 4 |
| 2 | Carbohydrates | Classification and stereochemistry, Structural properties, functional | 6 |

| | | | |
|---|---|---|---|
| | | importance of storage and transport of structural polysaccharides: sucrose, starch, glycogen, cellulose, pectin, hemicelluloses, chitin, muco-polysaccharides etc., Biosynthesis and role of N-linked and O-linked glycoproteins and proteoglycans. | |
| 3 | Lipids | Structure, classification and properties of lipids,<br>Lipid assembly, model membranes, formation of liposomes and drug targeting | 5 |
| 4 | Vitamins and Growth factors | Classification, role, estimation deficiency and diseases | 4 |
| 5 | Proteins | Amino acids: classification, structure and properties, Structural features of Proteins: Primary, secondary, tertiary and quaternary structure, Motives and domains.<br>Structural stabilization of proteins<br>Protein function. | 15 |
| 6 | Nucleic Acids | Nitrogen bases: nucleosides and nucleotides.<br>Historical basis of DNA structure<br>Fibre X-ray diffraction and single crystal X-ray diffraction study on DNA<br>A,B & Z form of DNA<br>Local distortion in DNA structure<br>Structure of Nucleozome<br>Structure of RNA<br>Properties of nucleic acids | 10 |
| **Total number of lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Text Book of Biochemistry by Nelson and Cox
- Biochemistry By Lubert Stryer Edn 3rd, 4th, and 5th.
- Biochemistry by Mathews.
- Nucleic acid structure W. Sanger
- Protein structure Schulz
- Protein Structure, Function & Architecture, Brandon & Tooze

**PRACTICAL IN INTRODUCTION TO BIO-MOLECULES**
**(4 Hrs. per week) Marks 100**

**LIST OF PRACTICALS**

1) Preparation of buffer solution.& demonstration of buffering action.
2) Determination of λmax & verification of Beer-Lambert's law; Determination of molar extinction co-efficient.
3) Preparation & standardization of laboratory reagents.
4) Qualitative detection of carbohydrates (Molish test, Benedicts test, Fehling's test, lead acetate test, inversion test, Seliwanoff's test, Osazone test).
5) Titration curve of Glycine.
6) Qualitative detection of Lipids (solubility test, Acroline test (for glycerol), and test for cholesterol
7) Quantitative detection of Proteins
8) Introduction to molecular Graphics software RasMol
9) Understanding Protein Structure using RasMol
10) Understanding DNA structure using RasMol

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 20 |
| Major test at the end of semester | 3 hours | 50 |
| **Total** | | **100** |

**TITLE OF THE COURSE: BIOSTATISTICS**

| **COURSE CODE: BS-203** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | 3 | 1 | 0 | 4 | 4 |

**OBJECTIVE**

The objective of the course is to familiarize the student with basic concepts in mathematics & statistics.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient understanding of different mathematics and statistical tools used in Biotechnology. This knowledge would be applicable in different industries

**PREREQUISITES**

Students should be familiar with school level mathematics to take up this course. In case they do not have mathematics at the twelth level they should have cleared the core mathematics in the first semester.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Lectures Required** |
|---|---|---|
| 1 | Determinant & Matrices :<br>1.2 Determinant<br>1.2.1 Definition & expansion of determinant of order 2 and 3<br>1.2.2 Cramer's rule to solve simultaneous equations in 2 and 3 unknowns. | 04 |
| | 1.2 Matrices:<br>1.2.1 Definition of Matrix of order mxn and types of Matrices.<br>1.2.2 Algebra of Matrices.<br>1.2.3 Transpose of a Matrix<br>1.2.4 Minor & cofactor of an element of a matrix<br>1.2.5 Adjoin of a Matrix.<br>1.2.6 Inverse of a Matrix by adjoin method | 10 |

| | | |
|---|---|---|
| | 1.2.7Solution of simultaneous equations containing 2 and 2 unknowns by Matrix inversion method. | |
| 2 | Complex Number :<br>2.1 Definition of Complex number, Cartesian, polar, exponential forms of complex number.<br>2.2 Algebra of Complex Number<br>2.3 De - Moiyre's theorem (without proof) and simple problems.<br>2.4 Euler's form of circular functions, Hyperbolic functions and relations between circular hyperbolic functions. | 04 |
| 3 | 3.1 Numerical Solution of Algebraic Equations :<br>3.1.1 Bisection Method<br>3.1.2 Regula – Falsi Method<br>3.1.3 Newton-Rophson Method | 06 |
| | 3.2 Numerical Solution of Simultaneous Equations :<br>3.2.1 Gauss elimination method.<br>3.2.2 Iterative Methods Gauss Seidal and Jacobi's Method. | 04 |
| | 3.3 Numerical Methods :<br>3.3.1 Solution of Linear & Non-Linear equation by<br>i) Trapezoidal Rule ii) Simpson's Rule | 02 |
| 4 | Set Theory and Probability<br>4.1 Set Theory<br>4.2 Probability :<br>4.2.1 Definition of random experiments, sample space, events, occurrence of event and types of events.<br>4.2.2 Definition of probability, addition and multiplication theorem of probability. | 04 |
| | 4.3 Probability Distribution<br>4.3.1 Binominal Distribution.<br>4.3.2 Poisson's Distribution.<br>4.3.3 Normal Distribution. | 04 |

| | | |
|---|---|---|
| 5 | Statistics<br>5.1 Frequency Distribution :<br>5.2 Measures of Control tendency (For Raw, Ungroup & group Data)<br>5.2.1 Mean<br>5.2.2 Median<br>5.2.3 Mode | <br>01<br>04 |
| | 5.3 Measures of Dispersion<br>5.3.1 Rauge, Variance, Coefficient of Cariance.<br>5.3.2 Standard Derivation. | 01 |
| 6 | Correlation & Regression | |
| | 6.1 Correlation<br>6.2 Regression | 01<br>01 |
| 7 | Chi square Test for independent attribute in RXC Table (Special case of 2x2 Table | 01 |
| 8 | F-Test | 01 |
| **Total Lectures** | | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials. In tutorials difficulties would be solved. Problems would be given. Students would be given assignments in the form of questions. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |

**BOOKS RECOMMENDED:**


- Fundamentals of Statistic by S. G. Gupta. 17th Ed. Himalaya Publications 2000
- Statistical Method in Biology by Bailey IIIrd Ed. University of Cambridge Press 1995.
- Statistics from biologist by Campbell R.C. Ed. 3. Cambridge University Press1989
- Fundamentals of Mathematical Statistics S. C. Gupta and Kapoor, S. C. Hand publication, New Delhi .1987.

**NAME OF THE COURSE: ENGINEERINGMECHANICS**

| **COURSE CODE: BT 201** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 150** | **3** | **0** | **2** | **5** | **4** |

**OBJECTIVES:**

The objective of the course is to familiarize the students with the basic concepts of engineering mechanics.

**LEARNING OUTCOME:**

At the end of the course the students will have sufficient knowledge of mechanical engineering techniques which will help them to implement them in the life sciences.

**PREREQUISITES:**

Since the course is technical in nature the students must have the basic knowledge of Math sans Physics.

**COURSE DESCRIPTION:**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Basics of mechanics | Introduction, Units and Dimensions<br>Laws of Mechanics<br>Vectors – Victorian representation of forces and moments, Vector operations. | 5 |
| 2 | Statics of particles | Coplanar Forces, Resolution and Composition of forces<br>Equilibrium of a particle, Forces in space<br>Equilibrium of a particle in space, Equivalent systems of forces<br>Principle of transmissibility, Single equivalent force. | 8 |
| 3 | Equilibrium of rigid bodies | Free body diagram<br>Types of supports and their reactions<br>Requirements of stable | 8 |

| | | | |
|---|---|---|---|
| | | equilibrium,<br>Equilibrium of rigid bodies in two dimensions,<br>Equilibrium of rigid bodies in three dimensions. | |
| 4 | Properties of surfaces and solids | Determination of Areas and Volumes<br>First moment of area and the centroid second and product moments of plane area<br>Parallel axis theorems and perpendicular axis theorems<br>Polar moment of inertia<br>Principal moments of inertia of plane areas<br>Principal axes of inertia<br>Mass moment of inertia & relation to area moments of inertia. | 7 |
| 5 | Friction | Frictional Force<br>Laws of Coloumb friction<br>Simple Contact friction<br>Rolling Resistance & Belt Friction | 5 |
| 6 | Dynamics of particles | Displacement,<br>Velocity, acceleration & their relationship<br>Relative motion<br>Curvilinear motion<br>Newton's Law of Motion<br>Work Energy Equation of particles.<br>Impulse and Momentum<br>Impact of elastic bodies | 8 |
| | **Total Lectures** | | **42** |

**METHODOLOGY:**

The course would be taught through lectures, demonstrations and practicals

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |

**BOOKS RECOMMENDED:**


1. Beer and Johnson, “Vector Mechanics for Engineers ", Vol. 1 " Statics “and “Dynamics ", Vol. 2. McGraw Hill International Edition, 1995.
2. Merriam, “Engineering Mechanics ", Vol.1 “Statics” and Vol.2 “Dynamics” 2nd Edition, Wiley International, 1988.
3. Rajasekaran S. and Sankara Subramanian, G., “Engineering Mechanics – Statics and Dynamics ". Sangam Books Ltd., 1999.
4. Irving, H., Shames, “Engineering Mechanics - Statics and Dynamics ", 3rd Edition, Prentice- Hall of India Pvt.Ltd,, 1993.
5. Timoshenko and Young, “Engineering Mechanics ", 4th Edition, McGraw Hill, 1995.
6. M cLean, “Engineering Mechanics’ ", 3rd Edition, SCHAUM Series, 1995.
7. Mokashi, V.S., “Engineering Mechanics ", Vol.1 “Statics” and Vol.2“Dynamics ", Tata McGraw Hill Books, 1996.

**PRACTICALS IN ENGINEERING MECHANICS**
**(2 Hrs. Per Week)** **50 Marks**

**LIST OF EXPERIMENTS:**

| Sr. No. | Name of the practical | Time ( Hrs) |
|---|---|---|
| 1. | Polygon law of coplanar forces. | 4 |
| 2. | Non concurrent non parallel (general) | 4 |
| 3. | Bell crank lever | 4 |
| 4. | Support reaction for beam | 4 |
| 5. | Simple / compound pendulum | 4 |
| 6. | Inclined plane (to determine coefficient of friction) | 4 |
| 7. | Collision of elastic bodies (Law of conservation of momentum) | 4 |
| 8. | Moment of inertia of fly wheel | 4 |
| 9. | Screw friction by using screw jack. | 4 |

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| Major test at the end of semester | 3 hours | 30 |
| **Total** | | **100** |

**NAME OF THE COURSE: C PROGRAMMING**

| **COURSE CODE: BI 201** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 200** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

- The objective of the course is to familiarize the students with programming concepts and apply these concepts to the real world problems.

**LEARNING OUTCOME**

At the end of this course student should be able to understand how Programming in C Language is done.

**PREREQUISITES**

Students should have obtained at least 50% marks in the course: Introduction to computers and programming concepts.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Introduction to C | An overview of C<br>C expressions<br>Operators | 2 |
| 2 | Data types: | Integers long and short<br>Integers, signed and unsigned<br>Chars, signed and unsigned<br>Floats and doubles | 2 |
| 3 | The Decision controls in C: | The ‘if’ statements within if<br>Multiple statements within if<br>The ‘if-else’ statement<br>The ! operator<br>Hierarchy of Logical Operators<br>The Conditional Operators | 4 |
| 4 | Loop control | Loops, The ‘While’ Loop, The ‘for’ loop | 5 |

| | | | |
|---|---|---|---|
| | structures: | Nesting of Loops<br>Multiple Initializations in the for loop<br>The 'Odd' Loop, The 'break' statement<br>The 'continue' statement, The 'do-while' statement | |
| 5 | Case control structures: | Decisions using switch<br>The goto statement | 1 |
| 6 | . Functions | What is a function? Why Use Functions<br>Passing values between functions,<br>Scope of functions | 7 |
| 7 | Array & strings: | Single-dimension Arrays, Generating a Pointer to an array, Passing single-dimension arrays to functions<br>Strings<br>Two-dimensional Arrays, Arrays of Strings<br>Multidimensional Arrays, Array Initialization<br>Variable-Length arrays | 6 |
| 8 | Puppeting on strings: | What are Strings?<br>More about Strings<br>Pointers and Strings<br>Standard Library String functions<br>Two-Dimensional Array of Characters<br>Array of pointers to Strings<br>Limitations of Array of Pointers to String | 4 |
| 9 | Pointers: | What are pointers?<br>Pointer variables<br>The pointer Operators<br>Pointer Expressions<br>Pointers and Arrays<br>Initializing Pointers<br>Pointers to Functions<br>C's Dynamic Allocation Arrays<br>Problems with Pointers | 6 |
| 10 | I/O in C: | Types of I/O | 4 |

| | | | |
|---|---|---|---|
| | | Console I/O Functions<br>Disk I/O functions<br>I/O under windows. | |
| 11 | Structures, Union, Enumeration & type definition: | Structures<br>Arrays of structures<br>Passing structures to functions<br>Structure Pointers<br>Unions<br>Bit-Fields<br>Enumerations<br>Typedef | 4 |
| Total number of lectures | | | 45 |

**METHODOLOGY**

The course would be taught through lectures, practical assignments by giving biological problems, quizzes, programming competition and practical classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |

**RECOMMENDED BOOKS**

- The complete reference of C 4th edition by Herbert Schildt
- Let us C By Yashwant Kanitakar
- C- programming by Balaguruswamy
- Data Structure by Kanitakar
- Pointers in C by Kanitakar
- Abhyankar
- Data Structure C and C++ by Taneumbam.
- C programming by Keinighan and Ritchite

**PRACTICAL IN C PROGRAMMING (4 Hrs. Per Week)**

**MARKS 100**

**LIST OF PRACTICALS**

1. 8 programs in basic programming in C
2. 8 programs using Decision Controls in C
3. 8 programs using Loop and Case Control structure
4. 8 programs illustrating use of function
5. 10 programs illustrating use of arrays and Structure
6. 5 programs using Pointers
7. 10 programs for Biological application
    - Finding complement of DNA
    - ORF finding
    - Inverted Repeats
    - Motif finding
    - Translation
    - Transcription etc.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| Major test at the end of semester | 3 hours | 60 |
| **Total** | | **100** |

**COURSE NAME: ENVIRONMENTAL SCIENCE**
**COURSE CODE: BS 204** **L T P Hr Cr**
**MARKS: 150** **3 0 2 5 4**

**OBJECTIVE OF THE COURSE:**
The objective of the course is to familiarize the students with the problems related to environmental pollution, loss of natural resources, climate change, solid waste disposal, biodiversity and social issues due to environmental degradation. It is also important for them to develop clear understanding of biodiversity and its conservation.

**LEARNING OUTCOME**
At the end of this course student should be able to understand importance and need of sustainable development.

**PREREQUISITES**
Since the course is very basic in nature there are no prerequisites.

**COURSE DESCRIPTION**

| **Seq. No** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Natural Resources and associated problems | Land, water, food, forest, mineral and energy resources, their use, over-exploitation and conservation. | 8 |
| 3 | Environmental Pollution | Definition, Causes, Effects and control measures of Air, Water, Soil, Noise, thermal and Marine Pollution. Nuclear hazards and Solid waste management. Role of an individual in prevention of Pollution and Pollution case studies | 8 |

| | | | |
|---|---|---|---|
| 4 | Biodiversity and its Conservation | Genetic, species and ecosystem diversity. Value of Biodiversity: social, ethical, aesthetic and option values. India as a mega diversity nation. Hotspots of Biodiversity. Threats to Biodiversity: Habitat loss, poaching of wildlife, man wild life conflicts. Endangered and Endemic species of India. Conservation of Biodiversity: in situ and ex situ conservation of biodiversity | 8 |
| 5 | Social Issues and the Environment | Urban problems related to energy. Water conservation, Rain water harvesting, and watershed management. Resettlement and rehabilitation of people. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation: Case studies. Environment protection Acts: Air (Prevention and control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Environmental ethics: Issues and possible solutions. Public awareness | 7 |
| 6 | Human Population and Environment | Population growth. Population explosion- family welfare programs. Environment and Human Health. Human Rights. HIV/ AIDS and Women and Child welfare. Role of Information and Technology in environment & human health. | 6 |

| | | | |
|---|---|---|---|
| 7 | Field work | Visit to a local area to document environmental assets River/forest/grassland/hill/mountain<br>Visit to local polluted site-Urban/Rural/Industrial/Agricultural<br>Study of Common plants, insects, birds.<br>Study of simple ecosystems- pond, river, hill slopes, etc | 5 |
| **Total number of lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and field work. The students will undertake field trip to sensitive hot spots in Western Ghats to observe and collect samples of Flora and Fauna for on the spot studies, collection and identification of specimens. These would be evaluated on the basis of report presented by the students

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |

**BOOKS RECOMMENDED:**


- Agarwal, K.. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- Bharucha Erach, The Biodiverstiy of India, Mapin Publishing Pvt. Ltd. Ahmedabad- 380013, India, Email: mapin@icenet.net (R)
- Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
- Cark R.S., Marine Pollution, Clanderson press Oxford (TB)
- Cunnigham, W.P.Cooper, T.H. Gorhani, E & Hepworth M.T. 2001

**PRACTICAL IN ENVIRONMENTAL SCIENCE**
**(2 Hrs. Per Week)** **MARKS 50**

**LIST OF PRACTICAL'S**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| Major test at the end of semester | 2.5 hours | 30 |
| **Total** | | **50** |

| SEMESTER III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BS 301 | Analytical Techniques | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 302 | Cell Biology | 3 | 0 | 2 | 5 | 4 | 150 |
| BS 303 | Microbiology | 3 | 0 | 4 | 7 | 5 | 200 |
| BS 304 | Genetics | 3 | 1 | 2 | 6 | 5 | 150 |
| BS 305 | Mammalian Physiology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 301 | Plant Physiology | 3 | 1 | 0 | 4 | 4 | 100 |
| **Total** | | **18** | **3** | **12** | **33** | **27** | **900** |

**TITLE OF THE COURSE: ANALYTICAL TECHNIQUES**

**COURSE CODE: BS-301** **L T P Hr C**

**MARKS: 100** **3 0 4 7 5**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to create general understanding of microscopy, electrophoresis, X-ray crystallography, Infra-red spectroscopy, Ultra-violet spectroscopy, nuclear magnetic resonance spectroscopy, mass spectroscopy, CD & ORD spectroscopy. They would also understand the importance of analytical tools in biotechnology & its applications in various industries

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in instrumentation used in Biotechnology. This is essential because he would be using these techniques in forth coming semesters.

**PREREQUISITES:**

This is an introductory course. School level knowledge of physics is sufficient. There are no prerequisites.

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Centrifugation | Introduction: Basic principles of sedimentation<br>Types of centrifuges<br>Design of centrifuges: Types of rotors<br>Ultracentrifuge: Analytical and Preparatory | 03 |
| 2 | Colorimetry and Spectroscopy | Properties of electromagnetic radiations, interaction with matter.<br>Ultraviolet spectroscopy: | 02<br><br>04 |

| | | | |
|---|---|---|---|
| | | Origin of UV spectra, types of transition, chromophore & related terms, effect of conjugation, choice of solvent, instrumentation and applications<br>Infra-red spectroscopy: Origin of infra-red spectra, modes of vibrations, instrumentation, sampling technique and applications<br>Nuclear magnetic resonance spectroscopy: Origin of NMR, continuous wave spectrometer, chemical shifts, spin-spin coupling, Karplus equation & curve, anisotropic effect, compounds containing $C^{13}$, $P^{31}$ & $F^{19}$, applications of NMR.<br>Mass Spectroscopy: Origin, Instrumentation, types of ions produced, interpretation and applications of mass spectra GCMS, LCMS & MSMS | 04<br>06<br>06 |
| 3 | Chromatography | Introduction:<br>Chromatography theory and practice.<br>Paper chromatography.<br>Thin layer chromatography.<br>Ion exchange chromatography.<br>Affinity chromatography.<br>Partition chromatography. | 09 |

| | | | |
|---|---|---|---|
| | | Adsorption chromatography. Introduction to gas chromatography and HPLC. Permeation. | |
| 4 | Electrophoresis | General principle, support media. Agarose gels, polyacrylamide gels. SDS PAGE, 2D PAGE Pulsed field gel electrophoresis Iso-electric focusing Capillary electrophoresis | 05 |
| 5 | Introduction to x-ray crystallography and Diffraction | Introduction, origin of x-rays, Bragg's equation, instrumentation and applications of x-ray absorption, instrumentation and applications of x-ray diffractions | 05 |
| 6 | Introduction to ORD & CD | Theory & applications of ORD & CD, the octant rule, | 04 |
| **Total Lectures** | | | **48** |

**METHODOLOGY:**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Practical Biochemistry – Wilson and Walker.
- A Biologist's guide to principle and techniques of practical biochemistry –Wilson and Golding.
- Principles of Instrumentation-Skoog.
- Analytical Chemistry- Anand and Chatwal.
- Analytical Chemistry – David Friefelder
- Biophysical chemistry by Nath and Upadhyay.
- Spectrometric analysis by P.N. Kalsi.
- Instrumental methods of chemical analysis by Gurdeep Chatwal and Sham Anand.

**PRACTICAL IN ANALYTICAL TECHNIQUES**
**(4 Hrs. Per Week)** **MARKS : 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| Major test at the end of semester | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: CELL BIOLOGY**

**COURSE CODE: BS 302** **L T P Hr C**

**MARKS : 150** **3 0 2 5 4**

**OBJECTIVE OF THE COURSE:**

- The objective of the course is to familiarize the students with basic concepts of cell Biology. This is essential for taking further courses in Biotechnology during the next couple of years.

**LEARNING OUTCOME:**

At the end of this course, student should be able to comprehend essentials of cell Biology useful for their understanding at the later stage.

**PREREQUISITES**

This is an introductory course. There are no prerequisites for the course.

**COURSE DESCRIPTION**

| Sr. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Cell as basic unit of living systems (Prokaryotes, Eukaryotes) | Pre-cellular evolution: artificial evolution of cells,<br>Broad classification of cell types, how cells are studied | 4 |
| 2 | Biochemical composition of cells | Proteins, Lipids, Carbohydrates, nucleic acids and Metabolic pool | 5 |
| 3 | Ultra-structure of the cell | Cell membrane and special functions of membrane | 3 |
| 5 | Cell-cell Interaction | Germ cells and Fertilization, Cellular mechanisms of development | 3 |
| 6 | Cell division and cell cycle, | | 5 |

| | | | |
|---|---|---|---|
| 7 | Differentiated cells and the maintenance of tissues | | 5 |
| 8 | Cell senescence and death | | 5 |
| **Total Number of lectures** | | | **44** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Cell and Molecular Biology by De Robertis.
- Molecular Biology of Cell by Bruce Alberts 2002.
- The cell by Cooper 2000
- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S Verma and VK Agarwaal. Publisher S. Chand and Comp. 2005
- Cell Biology by Powar

**PRACTICAL IN CELL BIOLOGY (2 hrs per week)**

**Marks 50**

**LIST OF EXPERIMENTS**

1. Microscopes- Different types of microscopes
    - Compound microscopes
    - Stereoscopic microscope
2. Observations of permanent slide
    - Stem Transverse Section – Dicot
    - Stem Transverse Section – Monocot
    - Different types of Animal Cell
3. Mitosis – Slide preparation and cell division
4. Meiosis - Slide preparation and cell division.
5. Preparation of slides and staining – Leaf Transverse Section and Stem Transverse Section

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: MICROBIOLOGY**

| **COURSE CODE: BS-303** | **L T P Hr C** |
|---|---|
| **MARKS: 200** | **3 0 4 7 5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with bacteria and viruses, their structures, metabolism, diseases caused by bacteria and viruses and their control.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of bacteria and viruses and diseases caused by them.

**PREREQUISITES**

Since the course is very basic in nature, school level knowledge in biology is sufficient to take the course and there are no prerequisites.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Introduction to Microbiology | Scope and history of Microbiology. Characterization, classification and identification of microorganism. Microscopic examination (Staining and microscopic techniques) | 6 |
| 2 | Microorganism-Bacteria | Morphology and fine structure of bacteria. Cell wall structure in details. Cultivation of bacteria. Reproduction and growth. Growth kinetics. Isolation and preservation. | 16 |
| 3 | Control of Microorganisms | Control of By physical and chemical agents. Role of antibiotics and chemotherapeutic agents | 4 |

| | | | |
|---|---|---|---|
| 4 | Microbial Physiology/ Metabolism | Microbial metabolism: Utilization of energy in Non-synthetic pathways (bacterial motility and transport of nutrients), Biosynthetic processes. Novel bacterial pathways. Energy production | 4 |
| 5 | Microbial organisms and diseases | Host microbe interactions. Diseases caused by bacteria | 4 |
| 6 | Microbes and environments | Symbiosis and antibiosis among microbial populations. $N_2$ fixations in agriculture | 10 |
| 7 | Viruses | Classification, structure and characterization of viruses | 4 |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- General Microbiology: Vol. I & 2 by Powar & Daginawala
- Microbiology by Pelczar
- Microbiology by Prescott
- General Microbiology by Stanier
- Instant notes in Microbiology by Nicklin.
- Principle of Fermentation technology by Stanbury & Witter

**PRACTICAL OF MICROBIOLOGY (4 hours per week)**

**Marks: 100**

**LIST OF EXPERIMENTS:**

1. Introduction to lab apparatus (instruments and glassware).
2. Washing, plugging & sterilization of test tubes.
3. Study of microscope & observation of permanent slides (mitosis, meiosis, prokaryotic and Eukaryotic cells.
4. Preparation of media-NA (nutrient agar), NB (nutrient Broth), PDA, (Potato dextrose agar) and LB media
5. Isolation of microbes from soil sample on nutrient agar slants.
6. Isolation of microbes from soil & bacterial suspension by streak plate method. Observation of microbial growth & study of colony characteristics
7. Staining Of Microbes:
    a. Monochromal
    b. Negative Staining,
    c. Grams Staining.
8. Endospores staining by Schaeffer and Fulton's method).
9. Effect of Environmental parameters on growth of microorganisms.
    a. Effect of pH.
    b. Effect of temperature.
    c. Effect of Buffered & unbuffered media.
    d. Effect of Osmotic pressure.
10. Growth curve of E.coli.
11. Testing of antiseptics & dyes in the control of microorganisms.

12. Metachromatic granules staining.
13. Counting of cells (of micro organisms by pour plate and spread plate technique/by Hemo cytometer)

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF COURSE: PLANT PHYSIOLOGY**

**COURSE CODE: BT 301** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in Plant Physiology and metabolism.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of plant physiology.

**PREREQUISITES**

Since the course is very advance in nature, student must know about different plant hormones and basic knowledge of plant anatomy and physiology.

**COURSE DESCRIPTION:**

| Sr No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction (special features of plants including anatomy, histology of plant tissues) | | 3 |
| 2 | Nitrogen fixation | Historical background. Nitrogen cycle in nature. Symbiotic nitrogen fixation. Nitrogenase system, nitrate reductase. | 4 |
| 3 | Plant hormones | Auxin , Gibbrellins, Cytokinins, Ethylene, Abscissic acid- Discovery, effect on growth and development. Gibberilins- Discovery, effect on growth and development. Cytokinins- Discovery, effect on | 8 |

| | | | |
|---|---|---|---|
| | | growth and developmeAbscisic acid<br>Ethylene. | |
| 4 | Phytochrome action and circadian rhythms. | The photochemical and biochemical properties of Phytochrome.<br>Localization of Phytochrome in tissues and cells.<br>Characteristic of Phytochrome. | 4 |
| 5 | Biochemistry of seed germination. | | 2 |
| 6 | Seed storage proteins. | | 2 |
| 7 | Physiology of flowering | | 2 |
| 8 | Physiology of fruit ripening. | | 2 |
| 9 | Secondary metabolites | Gums, pectins, alkaloids, flavonoids, rubber, essential oils and anthocyanins. | 6 |
| 10 | Plant nutrition deficiency (natural and synthetic) | Micro, macro, natural and synthetic nutrients and their deficiency syndrome | 3 |
| 11 | Stress physiology. | Water stress, Heat Stress, Chilling and Freezing stress<br>Salinity stress.<br>Temperature (high/low) | 6 |
| 12 | Plant metabolism-Photosynthesis | Intracellular organization of photosynthetic system.<br>Fundamental reactions of photosynthesis, photosynthetic pigments, role of light.<br>Hill reaction and its significance, light reactions, cyclic and non- | 6 |

| | | | |
|---|---|---|---|
| | | cyclic photo induced electron flow, energetics of photosynthesis, photorespiration, dark phase of photosynthesis, Calvin cycle, C-4 pathway, CAMP | |
| | | **Total** | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Plant Physiology by Lincon Taitz (Amazon Publication)
- Plant Physiology by Conn and Stumpf
- Plant Physiology by Noggle and Fritz
- Plant Physiology by Sallisbury and Ross
- Plant Physiology by Devlin

**COURSE NAME: GENETICS**

| **COURSE CODE: BS 304** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **2** | **6** | **5** |

**OBJECTIVE OF THE COURSE:**

In view of the increasing demand for training manpower in the area of Genetics, Molecular Biology, Genetic Medicine and Biotechnology, it was consensus of the committee (Faculties & experts) that this course should be broad based and should be able to give a good insight into modern biology and important component of hands-on training to the students.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Contact Hours** |
|---|---|---|---|
| 1 | Mendel's Principles of inheritance. | Mendel's experimental organism, the green pea.<br>Monohybrid cross: The principle of dominance and segregation.<br>Dihybrid cross: The principle of Independent assortment.<br>Application of Mendel's Principles<br>Punnett Square.<br>Forked Line Methods, Probability Chi Square method.<br>Mendel's Principle in Human Genetics.<br>Pedigree. Mendel's segregation in Human families. | 8 |
| 2 | Extension of Mendel's Principles allelic variation and gene function. | Incomplete dominance and co-dominance.<br>Multiple alleles.Allelic series.<br>Variation among the effect of the mutation.<br>Gene functions to produce polypeptides.<br>Gene Action: Genotype and | 5 |

| | | | |
|---|---|---|---|
| | | phenotype.<br>Influence of the environment.<br>Environmental effect on the expression of the Human Genes.<br>Gene Interaction. Epistasis. | |
| 3 | Chromosomal basis of inheritance | Chromosome Chromosome Number. Sex Chromosome.<br>The chromosomal theory of heredity.<br>Experimental evidence linking the inheritance of genes to chromosome.<br>Chromosome as arrays of gene.<br>Non-disjunction as proof of the chromosome theory.<br>Chromosomal basis of Mendel's Principles of segregation and Independent assortment.<br>Sex Linked Gene in Human Beings.<br>Sex Chromosome and Sex Determination.<br>Dosage Compensation of the X-linked genes. | 8 |
| 4 | Cytogenetics | Cytogenetical techniques.<br>Variations in chromosome structure.<br>Variations in chromosome number. | 5 |
| 5 | Non-Mendelian inheritance | Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), non-chromosomal inheritance, maternal linheritance, uniparental inheritance. | 6 |
| 6 | Genetic analysis of | Model organism for genetic analysis of development. | 5 |

| | | | |
|---|---|---|---|
| | development | Development results from differential gene expression. Genetic study: Genetic Regulation of the development of the Drosophila body plan | |
| 7 | Population genetics. | Theory of allelic frequencies. Natural Selection. Random Genetic Drift. | 5 |
| **Total Lecture** | | | **42** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**TEXT BOOKS:**

A text book of genetics by Sambhamurthy

**REFERENCE BOOKS:**

- Genetics by Russell
- Genetics by Klug
- Genetics by Tamarind
- Genetics by Snustad & Simmons
- Genetics by C.B Powar
- Genetics by B.D Singh
- Genetics by Pierce

**PRACTICAL IN GENETICS (2 Hrs. Per Week)**

**MARKS 50**

**Objective of the course:**

**The objective of the course is to familiarize the students with Genetic Subject**

List of Practical's

1) Model Organisms and their significance in Genetic studies:
   **Mendalian inheritance in Pea plants**
   **Virus – TMV (Tobacco leaves)**
   **Bacteria – E coil (slide)**
   **Neurospora and Yeast (slides)**
   **Paramecium (slides)**
   **Coenorhabites elegans.**
   **Drosophila melanogaster – Life Cycle**
   **Mosquito (Anopheles and Culex) – Life cycle**
   **Dissected reproductive system of Rat -**
   **Maize, Pea, Arabiodopsis – Life Cycle**
2) Induction of polyploidy in Onion root tips.
3) Methyl Green-Pyronin Staining of DNA
4) Dermatoglyphs of human fingers
5) Human Karyotype.
6) ABO Blood Gr
7) Genetic traits in population
8) Founder Effect
9) Isolation of Mitochondrial DNA
10) Plasmid DNA isolation
11) B Thalassemia
12) VNTR marker
13) Replica Plate Techniques
14) Growth curve analysis

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**NAME OF THE COURSE: MAMMALIAN PHYSIOLOGY**

| | L | T | P | Hr | C |
|---|---|---|---|---|---|
| **COURSE CODE: BS 305** | | | | | |
| **MARKS: 100** | **3** | **1** | **0** | **4** | **4** |

**OBJECTIVE OF THE COURSE:**

- The objective of the course is to develop insight of physiological aspects of the mammalian systems with respect to various interactions occurring with all the major organs of the body.
- This course will aim to develop skills linked to the understanding of the scientific literature that are introduced through different subjects like Microbiology, Cell Biology, Immunology and Pharmacology.
- The course is well equipped to deal with branches of biophysics, biochemistry and clinical applications as well.

**LEARNING OUTCOME**

The course would enable the student to understand the integral mechanism operating in the mammalian system along with the regulation of each system.

**ALSO THE STUDENTS SHOULD:**

Have an enhanced knowledge and appreciation of mammalian physiology

Have gained knowledge of a number of important physiological systems including the endocrinology, nervous system and reproductive systems

Be able to recognize and identify the principle tissue structures in those systems.

Be able to analyze and extrapolate from their knowledge of the separate systems to discuss physiological responses to challenges such as exercise, fasting and ascent of altitude.

**PREREQUISITES**

Since the course is very basic in nature school level knowledge in physics, chemistry & Biology is enough to take the course and there are no prerequisites.

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Basic concepts and principles: | Introduction and background (homeostasis, control systems). | 4 |
| 2 | The Physiology of Digestive system. | Anatomy and Histology of digestive system, Movement of food and absorption, Secretary functions of alimentary canal, digestion and absorption in gut, (liver and biliary system). | 7 |
| 3 | Physiology of Circulatory System. | Blood composition, blood pressure, and edema. The special fluid systems of the body – cerebrospinal, ocular, pleural, pericardial, peritoneal and synovial fluids. Regulation of the circulation, mean arterial pressure and hypertension, cardiac output and venous return, circulatory shock and its physiology, cardiac failure, coronary circulation. | 4 |
| 4 | Physiology of respiratory system | Anatomy and Histology of Respiratory organs. Pulmonary ventilation: Physical principles of gaseous exchange transport of $O_2$ | 4 |

| | | | |
|---|---|---|---|
| | | and $CO_2$ in the blood and body fluids. Chloride & reverse chloride shift | |
| 5 | Body fluids and Kidney-Physiology. | Anatomy and histology of Kidney Osmotic equilibrium between extra cellular and intracellular fluids, Formation of urine by kidney, glomerular filtration and tubular function regulation of urine concentration and auto regulation. | 4 |
| 6 | Endocrinology: | Histology of important glands like The pineal gland, Adrenal gland and their hormones: functions and disorders. Thyroid gland and their hormones: functions and disorders.<br>Insulin, glucagons and related disorders. Parathyroid hormone, calcitonin and calciterol.<br>Sex hormone: progesterone, estrogen and testosterone. | 4 |
| 7. | Reproductive system-Physiology | Male and female systems, Histology of male and female reproductive organs.<br>Maintenance of female reproductive system, Female Reproductive Cycle,<br>Sex hormones in puberty, menstrual cycle, menopause and inhibin function. | 5 |
| 8. | Nervous system-Physiology | Parts of the nervous system, Structure and function of sensory receptors, Neural circuits and Nerve conduction. | 8 |
| 9. | High altitude | Effect of low oxygen pressure, | 4 |

| | | | |
|---|---|---|---|
| | and space physiology: | Effect of high altitude on physiology,<br>Artificial climate in the sealed spacecraft,<br>Weightlessness in space. | |
| 10. | Physiology of deep sea diving and other hyper baric candidates. | Effect of high pressure and decompression on diver,<br>Hyper baric oxygen therapy. | 4 |
| **Total number of lectures** | | | **48** |

**COURSE DESCRIPTION**

**METHODOLOGY**

Lectures supported with PowerPoint presentation. Lectures and in-class activities are intended to complement assignment. Thus the course will be covered through lectures supported by tutorials. Students will be given seminar topics of their own interest from their syllabus. Again students are expected to collect review and make power point presentations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**REFERENCE BOOKS**


- Textbook of Medical Physiology by C. Guyton.
- Physiology by C. Chatterjee.
- Human Anatomy & Physiology by Tortora.
- Medical Biochemistry – Anant Narayan
- Text Book of Biochemistry by Harper Ed. 1988
- Medical physiology by Chaudhary.
- Anatomy and histology by Ross and Wilson
- Human Anatomy and Physiology by Creager

| SEMESTER IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 401 | Molecular Biology-I | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 402 | Metabolism | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 403 | Animal Tissue Culture | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 404 | Plant Tissue Culture | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 405 | Immunology | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 301 | Concepts in Bioinformatics | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **4** | **14** | **33** | **26** | **950** |

**TITLE OF THE COURSE: MOLECULAR BIOLOGY I**
**COURSE CODE: BT-401** **L T P Hr C**
**MARKS: 200** **3 0 4 7 5**

**OBJECTIVE OF THE COURSE:**
The objective of the course is to familiarize the students with advanced research area and basic concept in molecular biology

**LEARNING OUTCOME**
At the end of the course, the students will have sufficient scientific understanding of DNA structure, Replication, Transcription, Translation, Mutation, Recombination and Gene Expression .

**PREREQUISITES**
Since the course is very advance in nature, student must know about Gene structure and gene regulation. Student must have background with Genetics.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction: Chemistry and Genetics | What is gene? Molecular basis of genes,<br>DNA as genetic material,<br>Meselson and Stahl experiment for semiconservative mode of DNA replication,<br>What is Genetic Variation.<br>Origin of Genetic variability<br>Genetic information conveyed by sequences of nucleotides (central dogma),<br>discovery of RNA, synthesis of m-RNA,<br>what is genetic code. properties of genetic code<br>establishment of genetic code | **4** |
| 2 | Structure and | Structure of DNA (Structure of | 6 |

| | | | |
|---|---|---|---|
| | Maintenance of Genome: | purines, pyrimidines, De-oxy ribose sugar, Phosphoric acid, Nuceosides and Nucleotides)<br>Structure of RNA<br>What is Chromosome? Structure of chromosome, what is chromatin?<br>Chromosome and chromatin diversity<br>Chromosomal duplication and segregation, Nucleosome structure<br>Higher order chromatin structure, Regulation of chromatin structure<br>Mitochondrial genome.. | |
| 3 | Replication of DNA in Prokaryotes and Eukaryotes: | Chemistry of DNA synthesis, Mechanism of DNA polymerase, replication fork (Okazaki fragments)<br>Termination and control of DNA replication. | 7 |
| 4 | Mutation and DNA repair | Types of mutations.<br>Replication errors and their repairs.<br>DNA damage and repair. | 4 |
| 5 | Recombination: | Homologous recombination at molecular level: models of homologous recombination, proteins in homologous machines, homologous recombination in prokaryotes and Eukaryotes, mate typing,<br>genetic consequences of mechanism of recombination.<br>Site specific recombination and transposition of DNA: conservative site specific recombination, biological roles of sites recombination,<br>transposable elements, and their regulations, V9DJ recombinants<br>Gene conversion. | 10 |

| | | | |
|---|---|---|---|
| 6 | Transcription & Translation in | Transcription in Prokarotes (role of proteins and factors etc.)<br>Transcription in Eukaryotes (role of proteins and factors etc.)<br>RNA Splicing and RNA editing | 6 |
| 7 | Control of Gene Expression: | Prokaryotes, Lac Operon and Catabolite repression<br>Eukaryotes, Transcription Factors Yeast , Protozoan<br>Gene organization & expression in mitochondria and chloroplast<br>Post translation regulation of gene expression<br>Development and environmental regulation of gene expression | 7 |
| 8 | Oncogenes and Cancer: | Tumor cells,<br>tumor suppressors genes,<br>Transforming viruses | 4 |

**METHODOLOGY**

The course would be taught through lectures and assignments.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Instant notes in Molecular Biology by Turne.
- Microbial Genetics by David Freifelder.
- Molecular Biology by David Freifelder.
- Molecular Biology of Gene Watson, Baker et.al. 5$^{th}$ Edition
- Molecular Biology of the Cell by Alberts.
- Genes by Lewin and Benjamin.

**PRACTICAL IN MOLECULAR BIOLOGY I (4 hrs. Per Week)**
**MARKS 100**

**LIST OF PRACTICAL**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: METABOLISM**

**COURSE CODE: BT 402** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE OF THE COURSE:**

Metabolism is the set of chemical reactions that occur in living organisms in order to maintain life. These processes allow organisms to grow and reproduce, maintain their structures, and respond to their environments. The objective of the course is to familiarize the students to these various chemical reactions occurring in ones own body and the other living organisms alike.

**LEARNING OUTCOME:**

At the end of the course, students will have sufficient systematic and comprehensive knowledge about basic metabolism which will help them relate to the different physiological processes taking place in the cell and how inanimate chemicals cause life.

**PREREQUISITES**

The course requires that the students are well versed with properties and characters of biomolecules that they have learnt in their semester II, course no 202.

**COURSE DESCRIPTION:**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Survey of metabolism | Introduction to metabolism-catabolism, anabolism and intermediary metabolism | 1 |
| 2 | Glycolysis | Two phases of glycolysis-detailed study of all the reactions<br>Energy balance sheet, regulation of glycolysis by enzymes and hormones, Anaerobic pathway of glucose metabolism. | 3 |
| 3 | Gluconeogensis | Bypass reactions | 6 |

| | | | |
|---|---|---|---|
| | & Glycogen Metabolism | Regulation of gluconeogenesis by enzymes and hormones.<br>Glycogenolysis and glycogenesis | |
| 4 | Citric acid cycle(TCA) | Aerobic pathway of glucose metabolism- detailed study of all the reactions<br>Balance sheet. Regulation of the cycle | 4 |
| 5 | Alternate pathway of carbon metabolism | Pentose phosphate pathway (HMP shunt). | 2 |
| 6 | Lipid Metabolism | Requirement of carbon dioxide and citrate for biosynthesis, FAS complex & Regulation of biosynthesis<br>β oxidation of monounsaturated and polyunsaturated fatty acids,<br>Energetics of β oxidation,ketone bodies. | 2 |
| 7 | Oxidative phosphorylation | Oxidative phosphorylation, structure of ATPase enzyme, chemiosmotic hypothesis.<br>Complexes I, II, III and IV-components and structure.Reactions of the electron transfer. | 5 |
| 8 | Biosynthesis of triglycerides and membrane phospholipids cholesterol and steroid hormones | Biosynthesis of triglycerides and its hormonal regulation, phospholipids from CDP-diacyglycerol, plasmalogens, sphingolipid, glycerophospholipid, PDGF.<br>Cholesterol from acetyl CoA, fates of cholesterol, regulation of cholesterol biosynthesis, steroid hormones from cholesterol, bile | 9 |

| | | | |
|---|---|---|---|
| | | salts | |
| | Integration of Carbohydrates, lipids and fats metabolism | Integration of Carbohydrates, lipids and fats metabolism | 2 |
| | Biosynthesis of amino acids and its regulation | Glutamate, glutamine, proline and arginine from α- ketoglutatrate, Serine, glycine and cysteine from 3-phosphoglycerate Oxaloacetate and pyruvate as precursors for nonessential and essential amino acids Tryptophan, Phenylalanine and tyrosine from chorismate,regulation, transamination and deamination of amino acids | 6 |
| | Biosynthesis & catabolism of nucleotides | Purimidines & pyrimidines-De-novo and salvage pathways.,metabolic disorders | 4 |

**METHODOLOGY:**

The course should be taught through interactive lectures and demonstrations, which will help the students to relate the subject to everyday activity. Regular quizzing should be encouraged.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- The principles of Biochemistry by Nelson Cox
- Metabolic Pathways by Greenbrg
- Biochemistry by Lubert Stryer 3 rd Edition by W.H. Freeman and Co.
- Biochemistry by G. Zubay, Addision Wesly Publication [1988]
- Biochemistry by Corn and Stump

**TITLE OF THE COURSE: ANIMAL TISSUE CULTURE**

**COURSE CODE : BT 403** **L T P Hr C**

**MARKS: 100** **3 0 2 5 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the basics of Stem cells and Animal Tissue Culture Techniques and use of in various fields of research and human welfare.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of the Animal Tissue Culture techniques, knowledge of aseptic handling of cell lines. Use of these techniques in various fields of research and medicine and human welfare.

**PREREQUISITES**

Student should have background of cell biology, cell division, basic of aseptic laboratory techniques. They should know basic concept of various laboratory media.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction: | • History,<br>• Cell culture techniques,<br>• Equipment and sterilization methodology. | 4 |
| 2 | Introduction to animal cell cultures: | • Nutritional and physiological: Growth factors and growth parameters<br>• General metabolism | 6 |
| 3 | Primary cell cultures | • Establishment and maintenance of primary cell cultures of adherent and non-adherent cell lines with examples. | 4 |
| 4 | Secondary cell cultures | • Establishment and maintenance of secondary and continuous cell cultures | 2 |

| | | | |
|---|---|---|---|
| 5 | Characterization of cell lines | • Karyotyping, biochemical and genetic characterization of cell lines. | 2 |
| 6 | Application of cell cultures | • Use of Hybridoma for production of monoclonal antibodies. | 2 |
| 7 | Bioreactors in animal cells | • Bioreactors for large-scale culture of animal cells | 2 |
| 8 | Transplantation, tissue culturing. | • Transplantation techniques.<br>• Tissue Culturing | 3 |
| 9 | Cryopreservation and tissue culture applications | • Cryopreservation<br>• Tissue culture applications | 2 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and LCD PowerPoint presentation

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


- Cell and Tissue Culture by John Paul.Willams & wilkins Company. 2005.
- Basic Cell Culture Vol. 290 Protocols by Cheryl D Helgason, Cindy L Miller. Humanan Press.2005.
- Basic Cell Culture 2nd Edition by JM Davis Oxford University Press.2002.
- Tissue Culture in Biological Research by G. Penso and D. Balduki.
- Biotechnology by B. D. Singh: Expanding horizons.Kalyani Publishing. 2008..
- Principle of Fermentation Technology byStanbury P.F., Wittakar A. & Hall S.J. Pergamon Press. Oxford.1995.

**PRACTICAL OF ANIMAL TISSUE CULTURE (2 Hrs. Per Week)**

**MARKS 50**

**LIST OF EXPERIMENTS**

1. Laboratory set up for Animal tissue culture.
2. Equipments required for Animal tissue culture.
3. Preparation of cell medium.
4. Preparation of Calcium Magnesium free Phosphate buffer saline
5. Establishment of primary cell culture from chick embryo.
6. PBMC separation by using Ficoll density gradient method.
7. Passaging of monolayer cells using trypsinization protocol.
8. Counting of viable cells using hemocytometer.
9. Freezing and revival of cells.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: PLANT TISSUE CULTURE**

**COURSE CODE: BT 404** **L T P Hr C**

**MARKS: 150** **3 0 2 5 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in Plant Tissue Culture.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of different types of cell culture and new techniques used in Plant tissue culture.

**PREREQUISITES**

Since the course is very advance in nature, student must know about Sterilization techniques and basic knowledge of Plant tissue culture. Student must have background with Agriculture.

**COURSE DESCRIPTION**

| Sr. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | History. | Cell theory, Concept of cell culture,Development of Tissue Culture,Discovery of Auxins and cytokinins, cellular totipotency, history, various terminologies | 2 |
| 2 | Organization of plant tissue culture Laboratory | Aseptic Laboratory:Media preparation , Sterilization and Storage room, Different work areas:Media preparation room,Culture room Transplantation | 4 |

| | | | |
|---|---|---|---|
| | | area<br>Equipments and instruments required.. | |
| 3 | Aseptic techniques | Washing of glassware, Media sterilization<br>Aseptic workstation, Precautions to maintain aseptic conditions. | 4 |
| 4 | Culture medium | Nutritional requirements of the explants, PGR's and their in vitro roles, Media preparation | 3 |
| 5 | Callus culture technique | Introduction, principle, protocols<br>Genetic variation and applications | 3 |
| 6 | Suspension culture technique | Introduction, principle, protocols, Types, growth and growth measurement, Synchronization, application and limitations. | 3 |
| 7 | Organ culture technique | Introduction, principle, protocols<br>Root tips culture, leaf culture, shoot tip and meristem culture, ovary and ovule culture. | 3 |
| 8 | Anther and pollen culture technique | Introduction, principle, protocols, Haploids and its application | 3 |
| 9 | Protoplast culture | Define protoplast<br>What is protoplast culture<br>How protoplast fusion is done<br>Stages of protoplast cuylture,<br>Requirement and application | 7 |

| | | | |
|---|---|---|---|
| 10 | Micro propagation | Concept, requirements, stages, explants, mention of somaclonal variation<br>Different pathways of micropropagation:<br>Axillary bud proliferation<br>Somatic embryogenesis<br>Organogenesis.<br>Meristem culture | 6 |
| 11 | Secondary metabolites production and biotransformations. | Introduction, principal, optimization of yield.<br>Commercial aspects, applications and limitations. | 3 |
| 12 | Plant tissue culture production of: | Agricultural crops<br>Forest tree<br>Ornamental plants<br>Medicinal plants.<br>Endangered plant species. | 3 |
| 13 | Applications of Plant Tissue Culture: | Somatic hybridization<br>Somaclonal variation<br>Germplasm preservation<br>Genetic transformations<br>Production of artificial seeds.<br>Bioreactor:-Industrial application of tissue culture | 4 |
| | | Total no. of lectures | 48 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Plant tissue culture by A. C. Deb.
- Plant tissue culture by Dodds and Roberts.
- Biotechnology by H. D. Kumar.
- Biological science by Taylor.
- Biotechnology by B. D. Singh.

**PRACTICALS IN PLANT TISSUE CULTURE (2 hrs. Per Week)**
**MARKS 50**

**LIST OF PRACTICALS**

1. Setting up of a plant tissue culture laboratory
2. To maintain aseptic conditions in Plant tissue culture laboratory
3. Preparation of stock solution of different Cytokinins and Auxins
4. To develop callus culture from excised tap root of carrot
5. To culture embryo from Dicot seeds.
6. Cell suspension culture of Azadirachta indica

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: IMMUNOLOGY**

**COURSE CODE: BT 405** **L T P Hr C**

**MARKS: 150** **3 0 2 5 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the immune system and it's function and the advances in the immunology.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of immune system, molecular biology of antibody formation, various immunological assay and function of immune system in various microbial infections.

**PREREQUISITES**

Student should have background of cell biology. They should know basic concept of molecular biology also to understand expression off immunoglobulin gene. They should know some basic assays.

**COURSE DESCRIPTION**

| Sr. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction to immunology | • Overview of Immune system: History and scope of Immunology, Types of immunity: innate, acquired, Comparative immunity. Immune dysfunction and its consequences.<br>• b) Cells and Organs of Immune system: Cells of the immune system lymphoid cells: B, T and null cells, Primary lymphoid organs, secondary lymphoid organs-lymph nodes, | 6 |

| | | | |
|---|---|---|---|
| | | spleen mucosal associated lymphoid tissues | |
| 2 | Generation of B-cell and T- cell response: | • Antigens: Immunogenicity vs. antigenicity<br>• Epitopes (properties of B-cell and T-cell epitopes) | 4 |
| 3 | Immunoglobulins Structure and Function: | • Basic and fine structure of immune-globulin: light chains, heavy chains and sequences<br>• Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic<br>• Immunoglobulin super family | 6 |
| 4 | Immunoglobulin Classes and Biological Activity: | • Immunoglobulin mediated effectors functions optimization<br>• Activation of complement<br>• Antibody dependent cell mediated cytotoxicity.<br>• Clinical focus: Passive antibody therapy (IgG, IgM, IgA, IgE and IgD), hypersensitivity and immunological disorder | 6 |
| 5 | Organization and Expression of Immunoglobulin Genes: | • Genetic model compatible with Ig structure<br>• Multigene organization of Ig genes<br>• Variable region gene rearrangements<br>• Mechanism of variable region DNS rearrangements<br>• Generations of antibody diversity<br>• Class switching among constant regions genes<br>• Expression of Ig genes<br>• Regulation of Ig-gene transcription<br>• Antibody and genes and | 8 |

| | | | |
|---|---|---|---|
| | | antibody engineering<br>• Clinical focus | |
| 6 | Antigen Antibody Interactions: | • Strength of antigen and antibody interactions: Antibody affinity, antibody avidity<br>• Cross reactivity<br>• Precipitation reactions, agglutination reactions (immunodiffusion and immunoelectrophoretic technique)<br>• Radioimmunoassay<br>• Enzyme linked Immunosorbant./Assay(ELISA)<br>• Western Blotting<br>• Immuno precipitation<br>• Immunofluorenscence<br>• Flow cytometery and Fluorescence | 6 |
| 7 | MHC-Major Histo-compatibility complexes | • MHC molecules and genes | 4 |
| 8 | Immune System in Health and Disease: | • Immune response to infectious disease (viral, bacterial and protozoan)<br>• Vaccines (whole organism, purified macromolecules, recombinant vaccine, synthetic polypeptide etc.<br>• AIDS, and other acquired or secondary immuno deficiency orders<br>• Autoimmunity<br>• Transplantation immunology: graft rejections, graft vs host response<br>• Cancer and immune system | 8 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and LCD powerpoint presentation.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Immunology 5th edition by Janis Kuby ( W.H Freeman and company)*
2. Essentials of Immunology by Ivan M. Roitt 5th Edition Blackwell Scientific Publ.
3. Cellular and Molecular Immunology, 3rd edition, by Abbas
4. Molecular Biology of the Cell by Bruce Alberts

**PRACTICAL IN IMMUNOLOGY (2 Hrs. Per Week)**

**MARKS 50**

**LIST OF EXPERIMENTS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: CONCEPTS IN BIOINFORMATICS**

**COURSE CODE: BI-301** **L T P Hr C**

**MARKS: 200** **3 0 4 7 5**

**OBJECTIVE**

The objective of the course is to familiarize the student with basic concepts in Bioinformatics

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient understanding of Internet basics, Biological databases, warehousing of Biological data etc. This knowledge would be applicable in subsequent courses in Bioinformatics in the coming years.

**PREREQUISITES**

Students should be familiar with school level mathematics and Biology to take up this course. In case they do not have mathematics at the twelfth level they should have cleared the core mathematics in the first semester.

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detailed syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Overview of Bioinformatics | Scope and fields of Bioinformatics<br>Contribution to different problems in biology | 04 |
| 2 | Data acquisition, Database content, structure and annotation: | File formats<br>Annotated sequence databases<br>Genome and Organism specific database | 06 |
| 3 | Retrieval of | Data retrieval with Entrez and | 06 |

| | | | |
|---|---|---|---|
| | Biological Data | DBGET/ LinkDB , Data retrieval with SRS etc. | |
| 4 | Introduction to nucleic acid and protein databases | NCBI, EMBL, DDBJ, EBI NBRF-PIR, SWISSPROT, PDB etc. | 08 |
| 5 | Database similarity searches | BLAST , FASTA PSI-BLAST algorithms | 03 |
| 6 | Pairwise sequence allignment | Clustering algorithm PRAS Other MSA | 04 |
| 7 | Multiple sequence alignment | Clustering algorithm,PRAS, Other MSA | 04 |
| 8 | Patterns Motifs, and Profiles | Derivation and searching, Derived Databases of patterns, motifs and profiles Prosite, Blocks, Prints, Pfam etc. | 04 |
| 9 | Introduction to phylogenesis | Phylogenetics, cladistics and ontology Building phylogenetics trees Evolution of macromolecular sequences | 04 |
| 10 | Introduction to structural Bioinformatics | Amino acids, Polypeptide Composition, Secondary Composition Backbone flexibility □& ψ Angles, Ramchandran Plot Tertiary & Quaternary Structure Hydrophobicity, Disulphide bonds | 04 |

| | | | |
|---|---|---|---|
| | | Active Sites | |
| 11 | Introduction to | Homology, Analogy, Orthology Paralogy, Xenology | 02 |
| **Total Lectures** | | | **45** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials. In tutorials difficulties would be solved. Problems would be given. Students would be given assignments in the form of questions. There will be two class tests/ and surprise test conducted during the tutorial classes. Students would be asked to do presentations and assessed on the basis of their presentations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**


- Introduction to Bioinformatics Kothekar V.
- Introduction to Bioinformatics By T. K.Attawood & D.J. Parry-smith
- Bioinformatics By Arthur Lesk.
- Instant notes in Bioinformatics by S. Sundara rajan & R. Balaji

**PRACTICAL IN BIOINFORMATICS (4 Hrs. Per Week)**

**MARKS : 100**

**LIST OF PRACTICALS**

1. Introduction to Nucleic Acid and Protein Sequence Data Banks
   - NCBI
   - EMBL
   - DDBJ
   - EBI
   - NBRF-PIR,
   - SWISSPROT,
   - PDB etc.

2. Database Similarity Searches:
   - BLAST
   - FASTA
   - PSI-BLAST algorithms

3. Multiple sequence alignments –
   - Clustering algorithm
   - PRAS
   - Other MS

4. Patterns, motifs and Profiles in sequences:
   - PROSITE
   - BLOCKS
   - Prints
   - Pfam etc.

5. Data Structure Algorithms

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

| SEMESTER V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 501 | Molecular Biology-II | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 502 | rDNA Technology | 3 | 1 | 0 | 4 | 4 | **100** |
| BT 302 | Enzymology & Enzyme Technology | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 503 | Basic Pharmacology and Toxicology | 3 | 1 | 0 | 4 | 4 | **100** |
| BT 504 | Fermentation Technology | 3 | 0 | 4 | 7 | 5 | **200** |
| BT 506 / BT 507 | Elective-I | 3 | 0 | 4 | 7 | 5 | **200** |
| **Total** | | **18** | **2** | **16** | **36** | **28** | **1000** |
| **Elective I (BT 506 : Food Biotechnology / BT 507 : Environmental Biotechnology)** | | | | | | | |

**TITLE OF THE COURSE: MOLECULAR BIOLOGY – II**

| **COURSE CODE: BT 501** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 200** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with Structural details of the cellular anatomy, genetic material of prokaryotes and eukaryotes, transcription and translation of the genetic material, protein localization, regulation of genes in Prokaryotes and Eukaryotes, Gene families, movable genes and cancer.

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of DNA, the processes of transcription and translation and Gene regulation.

**PREREQUISITES:**

Since the course is an advanced level course, the student should have sufficient knowledge of DNA and its structure, basics of protein structure, cell anatomy and its compartmentalization and basics of microbiology.

**COURSE DESCRIPTION:**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Introduction to course | Review of structure of DNA and RNA, arrangements of Genetic material. | 02 |
| 2 | Transcription in prokaryotes and eukaryotes | .Transcription cycle in bacteria, role of proteins and factors of transcription, Transcription in eukaryotes, role of proteins and factors of transcription, RNA splicing and RNA editing. | 10 |

| | | | |
|---|---|---|---|
| 3 | Translation in prokaryotes and eukaryotes | Steps of translation, Initiation of translation, initiation factors, role of Met-tRNA, elongation and its factors, termination and protein stability | 08 |
| 4 | Post translational controls and protein localization in different organelles such as Mitochondria and lysosomes | Protein modifications, protein folding patterns, role of enzymes, protein transport of proteins in different organelles such as Mitochondria and lysosomes. | 08 |
| 5 | Gene Regulation | Gene regulation in prokaryotes, operon models, Gene regulation in eukaryotes, gene activators, enhancers and silencers, gene regulation during development with emphasis on Drosophila and plants. | 08 |
| 6 | Multigene families and clusters | Justification of the large nature of the genome, genome complexity, tandem repeats, micro and mini satellites. | 05 |
| 7 | Oncogenes and Cancer | Tumor cells, tumor suppressor genes, oncogenic viruses and transforming viruses. | 05 |
| 8 | Transposons and retroposons | Mechanism of action of transposons and retroposons, replication of transposons and retroposons and applications. | 02 |
| | | **Total number of Lectures** | **48** |

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

1 Instant notes in Molecular Biology by Turner.
2 Microbial Genetics by David Freifelder.
3 Molecular Biology by David Freifelder.
4 Molecular Biology of Gene by Watson, Baker et.al. 5$^{th}$ edition
5 Molecular Biology of the cell by Alberts.
6 Genes VII and VIII by Lewin and Benjamin.

**PRACTICAL IN MOLECULAR BIOLOGY – II**
**(4 Hrs. Per Week)** **MARKS: 100**

**LABORATORY DESCRIPTION**

| Sr. No. | Laboratory exercise | Hrs |
|---|---|---|
| 1 | DNA extraction from Plant materials | 4 |
| 2 | Agarose gel electrophoresis of DNA | 4 |
| 3 | Bacterial DNA extraction & Gel electrophoresis | 4 |
| 4 | Plasmid DNA extraction & Gel electrophoresis | 4 |
| 5 | Quantification of DNA by UV spectrophotometer | 4 |
| 6 | Demonstration of SDS-PAGE | 4 |
| 7 | Restriction digestion analysis | 4 |
| 8 | Preparation of competent cells & transformation | 4 |
| 9 | Replica Plate Techniques | 4 |

**METHODOLOGY:**
The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**

Molecular Cloning - Sambrook

**TITLE OF THE COURSE: RECOMBINANT DNA TECHNOLOGY**

| **COURSE CODE: BT-502** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **0** | **4** | **4** |

**OBJECTIVE**

To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology As well as create understanding and expertise in wet lab techniques in genetic engineering.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of application of Recombinant DNA techniques in Life Sciences Research.

**PREREQUISITES**

Knowledge of molecular biology is sufficient.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of Lectures** |
|---|---|---|---|
| 1 | Introduction | Landmarks in Molecular biology and biotechnology, Advantages of using microorganisms,<br>What is genetic engineering and recombinant DNA technology,<br>Control of gene expression and gene complexity in prokaryotes and eukaryotes.,<br>Genetic engineering in Ecoli and other prokaryotes, yeast, fungi and mammalian cells, | 10 |

| | | | |
|---|---|---|---|
| 2 | Tools in genetic engineering | Enzymes- DNA polymerases, restriction endonucleases, ligases, reverse transcriptases, nucleases, terminal transferases, phosphatases etc.<br>Cloning vectors-plasmids, bacteriophage vectors,cosmids,phagemids,vectors for plant and animal cells, shuttle vectors, YAC vectors, expression vectors etc.. | 6 |
| 3 | Gene cloning | Isolation and purification of DNA (genomic, plasmid) and RNA,, Isolation of gene of interest- restriction digestion, electrophoresis, blotting,,<br>Cutting and joining of DNA,,<br>Methods of gene transfer in prokaryotic and eukaryotic cells,<br>Recombinant selection and screening methods- genetic, immunochemical, South-western analysis, nucleic acid hybridization, HART, HRT,<br>Expression of cloned DNA molecules and maximization of expression, Cloning strategies- genomic DNA libraries, cDNA libraries, chromosome walking and jumping. | 10 |

| | | | |
|---|---|---|---|
| 4 | Recombinant DNA techniques | Blotting Techniques, Autoradiography, Hybridization, Molecular Probes and Nucleic acid labeling, DNA sequencing, PCR, Mutagenesis, Analysis of gene expression, DNA fingerprinting, RAPD, RFLP, AFLP. | 10 |
| 5 | Applications | Applications of Recombinant DNA technology | 02 |
| 6 | Protein interaction technology | Two-hybrid and other two component systems ,Detection using GST fusion protein, co-immunoprecipitation, FRE etc. | 04 |
| 7 | Gene therapy | In vivo approach, ex-vivo approach<br>Antisense therapy, Transgenics. | 02 |
| 8 | Genetic disorders-Diagnosis and screening | Prenatal diagnosis,<br>Single nucleotide polymorphisms,<br>DNA microarrays, Future strategies. | 02 |
| 9 | The Human Genome Project | The Human Genome Project details. | 02 |
| **Total Lectures** | | | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials, PowerPoint presentations, research articles and practical. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if

needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Biotechnology-Fundamentals and Applications- SS Purohit
2 Principles of gene manipulation-Old and Primrose
3 Gene Biotechnology-Jogdand
4 Molecular Biology-Twyman
5 Principles of genetics-Klug
6 Molecular Biology of the gene-Watson
7 Molecular Cloning (Vol 1,2,3)-Sambrook and Russell

**TITLE OF THE COURSE: ENZYMOLOGY AND ENZYME TECHNOLOGY**

**COURSE CODE : BT 302**

**L T P Hr C**

**MARKS: 200**

**3 0 4 7 5**

**OBJECTIVE:**

The objective of the course is to familiarize the student with enzymes, their kinetics, purification and applications in different fields

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of the enzymalogy. This knowledge would be applicable in different industries

**PREREQUISITES:**

This is an introductory course in enzymology. School level knowledge of organic chemistry and Biology is sufficient. There are no prerequisites.

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Enzymes | Classification: Trivial & EC system, Properties of enzymes. Enzyme substrate interactions, enzyme substrate complex, concept of active site, transition state theory, Effect of pH, temperature & substrate concentration on reaction rate. | 08 |
| | | Enzyme Catalysis: Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid-base, covalent & metal ion. Chemical modification of enzymes. | 2 |

| | | | |
|---|---|---|---|
| | | Isoenzymes and multiple forms of enzymes. | |
| 2 | Enzyme Kinetics & regulation of Enzyme action | Michaelis Menten equation, Significance of Km & Vmax.<br>Enzyme inhibition- types and their kinetics.<br>Enzyme activity, international units, specific activity, turnover number.<br>Structure-Function Relations: chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference to carboxypeptidases. Ribozymes. | 10<br><br><br><br>5 |
| 3 | Allosteric interactions & Enzyme Regulations | Types, positive & negative cooperativity, theory of concerted & sequential models, kinetics of Allosteric enzymes.Enzyme Regulation: Feed back, covalent & Zymogen activation, Allosteric regulation. | 4 |
| 4 | Immobilization of enzymes & applications | Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids) , microencapsulation and gel entrapment, kinetics of immobilized enzyme. Applications of enzymes: Food processing,<br>Medicine, Diagnostics, Production of new compounds, As research tools (ELISA method)<br>Leather industry, textile industry. | 8 |
| 5 | Enzyme Technology | Recent advances in enzyme technology, Use of unnatural' substrates, Enzyme engineering, Artificial enzymes, Coenzyme-regenerating systems. | 8 |
| **Total Lectures** | | | 45 |

**METHODOLOGY:**

The course will be covered through lectures supported by tutorials. In tutorials would discuss different applications of enzymes and methods of their extractions and purification. Students would be given assignments in the form of questions. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Fundamentals of Enzymology. Nicolas C. Price and Lewis Stevens. Oxford University press. 2000.
- Enzymes. Trevor Palmer.Horwood Publishing. 2001.
- Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox.Vth Ed.Palgrave Macmillan Pblication.2008.
- Biochemistry by Stryer( $4^{th}$ edn)
- Fundamentals of Biochemistry by A. C. Deb.
- Biochemistry by Zubay.

**PRACTICAL IN ENZYMOLOGY AND ENZYME TECHNOLOGY (4 Hrs. Per Week)** **MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: BASIC PHARMACOLOGY AND TOXICOLOGY**

**COURSE CODE: BT-504** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE:**

The objective of the course is to familiarize the students with aspects of Pharmacology and toxicity of different chemical compounds.

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of quantitative and qualitative role and mechanisms of toxic chemical compounds.

**PREREQUISITES:**

Since the course is very basic in scientific world, student must know about graphical relation between doses is to response relationship with biological cell.

**COURSE DESCRIPTION:**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | **Toxicology Introduction** | Definition and derivation of toxicology<br>Sister sciences, endocrinology and pharmacology<br>Definition of toxins and toxicants<br>Key features of toxicology and study of toxicants<br>Modes of exposure, elimination, bioavailability, partition | **02** |
| 2 | **Dose Response** | Toxicant targets<br>Physiologic dose-response<br>The role of intercellular chemical | **04** |

| | | | |
|---|---|---|---|
| | | communication: hormone, receptor, transducer, effectors<br>Agonist, antagonist<br>Interconnections of transduction mechanisms | |
| **3** | **Chemical Kinetics** | Principles and practice of transition state mimicry<br>Illustrative examples, collected substrate analog inhibitors ,and design strategies | **06** |
| **4** | **Cell death** | Necrosis, Apoptosis;<br>Neural and immune function overview | **04** |
| **5** | **Metabolism** | Biochemistry of toxicant metabolism<br>Enter hepatic circulation<br>Toxic dynamics and toxic kinetic**s** | **05** |
| **6** | **Reproduction** | Gamete production in mammals<br>Gestation in mammals | **06** |
| **7** | **Mammalian toxicity** | Mammalian toxicity testing: in vivo, in vitro,<br>Multigenerational<br>Molecular methods, high throughput testing | **05** |
| **8** | **Dosage** | Stress and dose interactions<br>Diet as modulator or mode of exposure<br>Developmental status/age and toxicity<br>Predispositions to toxic risk<br>Moderators of toxic risk<br>Carcinogenesis | **10** |
| **9** | **Clinical Developments** | Screening systems and their construction strategies<br>Alternative strategies in lead identification, lead optimization, pre-clinical development: Clinical trials, patenting and clearance for application | **06** |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY :**
The course would be taught through lectures, demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Klaassen. McGraw-Hill:New York, NY. 2001. 1236 pp.
2. Casarett & Doull's Toxicology: The Basic Science of Poisons, 6th Ed.

**COURSE NAME: FERMENTATION TECHNOLOGY**

| **COURSE CODE: BT 505** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 200** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the experimental tools used in Industrial microbiology and fermentation technology. The students would learn industrial techniques as: Isolation, improvement, maintenance and preservation of microbial cultures, Design of media, bioreactors and downstream processes along with production studies during the tenure of their study.

**LEARNING OUTCOME**

At the end of this course student would be able to understand basic principles of fermentation technology as used in Biotechnology.

**PREREQUISITES**

Since the course is very basic in nature, school level knowledge in physics, chemistry & Biology is enough to take the course and there are no prerequisites.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Introduction to fermentation technology | -Historical background<br>-Important industrial biotechnologically derived products | 2 |
| 2 | Fermentation Design | -Design of fermenter and its components (construction, impellers, valves, spargers, other attachments of the system)<br>-Layout of Fermenter unit and laboratory | **8** |

| | | | |
|---|---|---|---|
| | | -Operation details of fermentation and trouble shooting<br>-Bioreactor types for products of microbial, plant and animal origin<br>-Role of computers in fermentation processes | |
| 3 | Sterilization | -Sterilization of Fermenter (batch and continuous processes)<br>-feed sterilization<br>-sterilization of liquid wastes<br>-Filter sterilization | 4 |
| 4 | Isolation of microbes and Strain improvement | -Isolation and preservation of industrially important microbes<br>-Strain improvement by recombinant DNA techniques, isolation of mutants, etc | 4 |
| 5 | Design of media and inoculum development | -Nutritional media for microorganisms, their formulation, sterilization, screening and economy for proper growth of industrial microbes<br>- identification of variables important for fermentation<br>-Medium optimization using conventional and statistical designs<br>- Inoculum development for bacterial, fungal and yeast strains<br>-Aseptic inoculation in fermenter | 7 |
| 6 | Microbial Growth Kinetics | Kinetics of growth<br>-in batch culture<br>-in continuous culture<br>-fed-batch culture | 6 |
| 7 | Downstream processing | -Cell separation techniques<br>-Concentration of metabolites<br>-Purification of metabolites | 9 |

| | | | |
|---|---|---|---|
| | | -Crystallization and drying | |
| 8 | Biosynthesis of metabolites with examples | -Industrial production of Antibiotics , enzymes, organic acids ,vitamins, amino acids, solvents, beverages and single cell protein | 8 |
| **Total number of lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations, tutorials and practical training.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**

**TEXT BOOKS**


1. Principles of fermentation technology by P F STANBURY, S. Hall, A. Whitaker., Pergamon Press, USA.
2. W Cruger and A Cruger A Textbook of Industrial Microbiology 2nd Edition Sinauer Associates Sunderland US 2004
3. A.H. Patel. Industrial Microbiology. MacMillan. 2000.
4. Casida, L E JR 1984 Industrial Microbiology. Wiley Eastern (revised editions)

**PRACTICAL IN FERMENTATION TECHNOLOGY**
**(4 Hrs. Per Week)** **MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: ELECTIVE 1 FOOD BIOTECHNOLOGY**

**COURSE CODE: BT-506** **L T P Hr C**

**MARKS: 200** **3 0 4 7 5**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in Food Biotechnology

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of different types of biotechnological methods to improve the value of different food and new techniques used in Food Biotechnology.

**PREREQUISITES**

Since the course is very advance in science, student must know about the new biotechnological and molecular genetics method which to apply in food. Student must have background with Biotechnological aspects and molecular genetics.

**COURSE DESCRIPTION**

| Seq. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction to Food Biotechnology | Biotechnology application to food stuffs<br>Career in Food Biotechnology<br>Activities of Food Biotechnologist | 02 |
| 2 | Biotechnology in Food Processing | Unit Operation in Food Processing<br>Quality Factors in Preprocessed Food<br>Food deterioration and its control<br>Rheology of Food products | 14 |

| | | | |
|---|---|---|---|
| 3 | Molecular methods and Production | Methods And application of molecular cloning in foods Developmental technique for new plant verities | 06 |
| 4 | Application of Biotechnology to Food products | Microbial role in food products Yeast, Bacterial and other microorganisms based process and products | 16 |
| 5 | Modification and Bioconversion of food raw materials | Bioconversion of whey, molasses and starch and other food waste for value addition | 06 |
| 6 | Regulatory and Social aspects of Food Biotechnology | Modern Biotechnological regulatory aspects in food industries Biotechnology and Food : A Social Appraisal | 04 |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Food Biotechnology: Dietrich Knorr,Inc.New York and Basel
2 Food Science: Potter N.N. CBS publication
3 Handbook of Food Biotechnology : NIIR Board of Consultants and Engg., NIIR
4 Food Science and Technology: B.S.Khattar,Daya Publishing House,Delhi
5 Biotechnology: B.D.Singh,Kalyani Publishers
6 Food Microbiology: Frazier

**PRACTICALS IN FOOD BIOTECHNOLOGY (ELECTIVE I)**
**(4 Hrs. Per Week) MARKS: 100**

**OBJECTIVE:**
Objective of course is to familiarize the students with basic aspects of food microbiology, estimation of minerals from food products, chemical preservatives.

**LEARNING OUTCOME:**
At the end of the course, the students will be able to study & correlate the quality of food and food products on the basis of chemical & microbial analysis.

**PREREQUISITES:**
This is a basis course regarding study of food products parameters.

**COURSE DESCRIPTION**

| Sr. No. | Topics | No. of Lectures |
|---|---|---|
| 1 | Determination of quality of milk by MBRT test | 04 |
| 2 | Detection of number of bacteria by SPC method | 04 |
| 3 | Microscopic determination of microbial flora from yoghurt and lactic acid determination | 04 |
| 4 | Microbial examination of food | 04 |
| 5 | Detection of pathogenic bacteria from food samples | 04 |
| 7 | Preparation of Cheese | 04 |
| 8 | To determine mineral salt concentrations in fruit juices by using flame photometer | 04 |
| 9 | To check the food efficacy testing of chemical preservatives | 04 |
| 10 | Preparation of Bread | 04 |

**METHODOLOGY**

The course will be covered through practical work supported by field study. Students would be made to gain scientific data information using various food products resources. They would be taught how to improve quality and useful microbial flora to food products.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

1) Practical in Food Microbiology
2) Practical in Microbiology : Kannan

**TITLE OF THE COURSE: ELECTIVE 1 ENVIRONMENTAL BIOTECHNOLOGY**

**COURSE CODE: BT-507** **L T P Hr C**

**MARKS: 200** **3 0 4 7 5**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in Environmental Biotechnology

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of different types of biotechnological methods to improve environment value and new techniques used in Environmental Biotechnology.

**PREREQUISITES**

Since the course is very basic in science, student must know about the new biotechnological methods which to apply in environment. Student must have background with Biotechnological aspects and molecular genetics.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Environment | Introduction and History<br>Global warming<br>Depletion of ozone layer | 03 |
| 2 | Environmental Pollution | Types of Pollution<br>Water pollution, Soil Pollution, Air Pollution, Noise Pollution<br>Sources of pollution<br>Collection of samples from different sources | 04 |

| | | | |
|---|---|---|---|
| 3 | Air pollution and its control | Active trace gases in air<br>Aerosols in air<br>Control of air pollution through biotechnology | 03 |
| 4 | Microbiology of waste water treatment | Aerobic System<br>Biological processes for domestic and industrial waste water treatments; Aerobic systems - activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), Fluidized bed reactor (FBR), expanded bed reactor, Inverse fluidized bed biofilm reactor (IFBBR) packed bed reactors air- sparged reactors.<br>Anaerobic System Anaerobic biological treatment - contact digesters, packed column reactors, UASB. | 06 |
| 5 | Microbiology of degradation of xenobiotics | Xenobiotics in environment<br>Decay behavior of xenobiotics | 04 |
| 6 | Bioremediation | Bioremediation I<br>Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation<br>Bioremediation- II<br>Solid phase bioremediation - land farming, prepared beds, Phytoremediation, Composting, Bioventing & Biosparging, Liquid phase bioremediation - suspended bioreactors, fixed biofilm reactors. | 06 |

| | | | |
|---|---|---|---|
| | | Role of genetic engineering | |
| 7 | Mining and Metal biotechnology – with special reference to Copper & Iron. | Sources<br>Microbial transformation, accumulation and concentration of metals, metal leaching, extraction, biosorption and future prospects. | 04 |
| 8 | Bio Fuels | Microorganisms and energy requirements of mankind, Production of nonconventional<br>fuels - Methane (Biogas), Hydrogen, Alcohols and algal hydrocarbons, Use of microorganisms in augmentation of petroleum recovery. | 06 |
| 9 | Hazardous Waste Management | Biotechnology application to hazardous waste management - examples of<br>biotechnological applications to hazardous waste management - cyanide<br>detoxification - detoxification of oxalate, urea etc. - toxic organics - phenols. | 6 |
| 10 | Advances in Environmental Biotechnology | GIS in Environmental Management<br>Computer based Environmental modeling<br>Design of ETPs | 06 |
| Total number of Lectures | | | 48 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Textbook of Biotechnology-H.K.Das
2 Textbook of Biotechnology-Purohit
3 Stanier R. Y., Ingram J.L., Wheelis M.L., Painter R.R., General Microbiology,
McMillan Publications, 1989.
4 Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 1987.
5 Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol.4, Gulf Publications Co. London, 1989.
6 Bioremediation engineering; design and application 1995 John. T. cookson, Jr. Mc Graw Hill, Inc.

**PRACTICALS IN ENVIRONMENTAL BIOTECHNOLOGY**
**(4 Hrs. Per Week) MARKS: 100**

1) **Methods of sampling for pollution measurement**
   a) Statistical design for collection of samples from site
   b) Air sampling (Impaction)
   c) Soil sampling (soil probes/auger)
   d) Water sampling (Niskin type or equivalent depth sampling)

2) **Methods of Pollution Measurement (as per Indian and global recommendations)**
   a) Air pollution by measurement of SOX (sulphur oxides-di), NOX (nitrous oxide-di) and suspended particulate matter.
   b) Water pollution by measurement of water conductivity, pH, dissolved oxygen, and turbidity.
   c) Soil pollution by measurement of metals and organic compounds.
   d) At least one representative biological indicator for each of air (lichens), water (Macroinvertebrate) and soil (Moss) pollution.
   e) Graphical representation of the data collected after analysis of samples and comparison of values with Indian and Global standards.

3) **Community analysis of polluted and non-polluted sites by PCR based methods** (eukaryotic and prokaryotic domain primers). Comparison of polluted versus non-polluted sites to ascertain the possible alteration in community structure introduced due to pollutant.

4) **Microbial biodegradation (aerobic and anaerobic) of any one pollutant** (e.g. hydrocarbon) or any xenobiotic and study of its decay behaviour.

5) **Bioremediation –** Monitoring uptake of heavy metals using biological methods- organisms.

6) **Demonstration** for biogas production/ visit to wastewater plant/ biogas plant.

**Note: Wherever it is not possible to perform the experiment due to limitation of equipment or other reasons, a demonstration will be arranged, however no more than 10% practical's will be demonstrations.**

| SEMESTER VI | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 601 | Virology | 3 | 1 | 0 | 4 | 4 | 100 |
| HU 601 | Principles of Managements & Entrepreneurial Development | 3 | 0 | 0 | 3 | 3 | 100 |
| BI 605 | Introduction to Molecular Modeling and Chemo informatics | 3 | 0 | 4 | 7 | 5 | 200 |
| HU 602 | Bio safety and Bioethics & IPR | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 602 | Genomics | 3 | 0 | 2 | 5 | 4 | 150 |
| BI 504 / BI 606 / BI 603 | Elective-II | 3 | 1 | 2 | 6 | 5 | 150 |
| **Total** | | **18** | **3** | **8** | **29** | **25** | **800** |
| **Elective II (BI 504: Operating System / BI 603:Perl & Bioperl / BI 606:Computer Networking)** | | | | | | | |

## Semester VI

| Course Code | Course Name | L | T | P | Hr | Cr |
|---|---|---|---|---|---|---|
| BT601 | Virology | 3 | 1 | 0 | 4 | 4 |
| HU601 | Principles of Management and Entrepreneurial Developments | 3 | 0 | 0 | 3 | 3 |
| HU 602 | Biosafety, Bioethics & IPR | 3 | 1 | 0 | 4 | 4 |
| BT 602 | Genomics, Transcriptomics & Proteomics | 3 | 1 | 2 | 6 | 5 |
| BT 603 | Biochemical Engineering | 3 | 0 | 4 | 7 | 5 |
| BI 504 / BI 606/ BI 603 | Elective II | 3 | 0 | 2 | 5 | 4 |
| **Total** | | **18** | **3** | **8** | **29** | **25** |

**Elective II:**

**BI 504: Operating Systems**
**BI 603: Perl & Bioperl**
**BI 606: Computer Networking**

**TITLE OF THE COURSE: VIROLOGY**

| **COURSE CODE: BT 601** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **0** | **4** | **4** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with Viruses, their structure, Plant and Animal viruses and Molecular Virology.

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of types of viruses and the various diseases caused by viruses.

**PREREQUISITES:**

Since the course is an advanced level course, the student should have sufficient knowledge of Microbiology, DNA, and RNA.

**COURSE DESCRIPTION:**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | The Viruses | Discovery, virus structure, classification, viral replication cycle, detection and enumeration of viruses, virus cultivation in lab, viriods, prions. | 10 |
| 2 | Bacteriophages | Morphology, life cycle of viruses, reproduction of ds DNA phages, ss DNA phages and RNA phages, Lysogeny. | 10 |
| 3 | Plant Viruses | Nomenclature and classification, viruses of fungi, algae and protozoa, viruses infecting fruits and vegetables. | 09 |
| 4 | Animal Viruses | Viruses containing ss(+) RNA, ss(-) RNA, ds RNA and DNA and ssDNA, RNA tumor viruses requiring DNA intermediate for synthesis, Miscellaneous viruses. | 13 |

| | | | |
|---|---|---|---|
| 5 | Molecular Virology | Retroviruses and influenza viruses, interferons. | 06 |
| | | Total number of Lectures | 48 |

**METHODOLOGY:**
The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Microbiology by Pelczar.
2 Microbiology by Atlas.
3 Field's Virology.
4 Virology by Biswas and Biswas.
5 Microbiology by Prescott.

**TITLE OF THE COURSE: PRINCIPLES OF MANAGEMENT AND ENTREPRENEURIAL DEVELOPMENTS**

| **COURSE CODE: HU 601** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **0** | **3** | **3** |

**OBJECTIVE OF THE COURSE**:

The objective of the course is to prepare students competent in the field of quality control management of drugs and biopharmaceutical. The aim of the course is to create a general motivation amongst students to critically analyze the problem and how to apply the knowledge of quality management in their future endeavor. To prepare them to think independently for making newer project through literature survey, writing a review article on a topic aned 15 min. presentation to the class.

**LEARNING OUTCOME**

At the end of the semester it is expected that student understood the basics of quality control management practice in the industry and research labs., It is expected that they will be more confident to develop and implement the same policies in their research projects either for pursuing their higher education or for industrial application

**PREREQUISITE**

This is an advance level course. Students must have an understanding of introduction chemistry, Biology, Biochemistry , Microbiology, Pharmacology and toxicology of drugs, plant and animal biology,

**COURSE DESCRIPTION**

| Sr. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Management Principles: | Role of managers and leaders in biotechnology companies<br>Innovative problem solving strategies<br>Diverse and global work force<br>Developing partnerships with other businesses<br>Customers and competitors<br>Utilization of technology<br>Current challenges in organization<br>Leadership skills, communication, conflict resolution, goal integration | 20 |
| 2 | Creating Biotechnology Enterprise: | Market assessment of innovative technology<br>Patents and licensing<br>Corporate law<br>Preparation of a business plan<br>Raising money from venture capitalists<br>Government grants<br>Strategic alliances<br>Sales and marketing<br>Real estate<br>Human resources<br>Regulatory affairs<br>Preparation of business plan for biotech start-up | 25 |
| | | **Total lecture** | **45** |

**METHODOLOGY**

The course would be covered through lectures, supported by quizzes and case history discussion. A visit to pharma industry after the study will help their understanding om the sinkect. The students will be evaluated based pm twp c;ass test, lecture attendance, class participation, Write-up and power point presentation.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Principles of management byEllen A Benowitz
2 Greatest management principles in world by Michael Leboeuf
3 Management-principles and practices by Garry Dessler

**TITLE OF THE COURSE: INTRODUCTION TO MOLECULAR MODELING AND CHEMO INFORMATICS**

**COURSE CODE : BI-605** **L T P Hr C**

**MARKS: 100** **3 1 4 8 6**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with molecular modeling concepts and molecular modeling softwares.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient knowledge of how the molecules could be built and what are the various details associated with the field.

**PREREQUISITES**

Since course deals with molecular modeling students should have basics of Maths, Physics and Chemistry of molecules.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction to molecular graphics | What are different coordinate systems?<br>Basic principle of molecular graphics and structure visualization.<br>Different molecular graphics packages.<br>Protein Data Bank. | 8 |
| 2. | Building of small molecules | Building of small molecules<br>Methods used in building small molecules using crystal, cartesian,<br>polar and chemical internal coordinates.<br>Building of Biopolymers DNA & oligopeptides in different secondary structure | 14 |
| 3. | Optimization of geometries | Energy minimization by systematic search method<br>Plotting conformation energy contours | 12 |

| | | | |
|---|---|---|---|
| | of small molecules | (Ramachandran plot), and finding out minimum energy conformation<br>Gradient based Energy minimization<br>Molecular mechanics approach<br>Molecular Dynamics method<br>Monte Carlo method<br>Genetic algorithm | |
| 4. | Use of Quantum chemical methods for geometry optimization | Schrödinger equation<br>Basic Formalism in quantum mechanics<br>Schrödinger equation for a multi- electron atom<br>Schrödinger equation for a molecule<br>Hartree- Fock Method<br>Different MO methods<br>Molecular electrostatic potential<br>Optimization of geometries of small molecules<br>Quantum chemical indices | 14 |
| **Total hours** | | | 48 |

**METHODOLOGY**

The course would be taught through lectures, practicals and assignments.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Molecular modeling by Andrew Leach
- **Molecular Modeling, Holtje and Folkers G Weinheim New York**

**PRACTICALS IN INTRODUCTION TO MOLECULAR MODELING AND CHEMO INFORMATICS (4 Hrs.)**

**MARKS: 100**

**LIST OF EXPERIMENTS:**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: BIOSAFETY, BIOETHICS AND INTELLECTUAL PROPERTY RIGHTS**

**COURSE CODE: HU 602** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE:**

The objective of the course is to make students learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products. The biotechnology students suppose to understand and follow the regulatory framework important for the product safety and benefit for the society. The students are given case history to discuss and express their views.

**LEARNING OUTCOME**

At the end of the course, it is expected that students have understood the basic issues of Biosafety, Bioethics and IPR.IT is expected that they will be more confidant to practice and implement all these policies in their future endeavor.

**PREREQUISITES**

This is an advance level course. Students must have an understanding of introductory undergraduate level course such as chemistry, biology, microbiology, plant and animal biology and molecular biology.

**COURSE DESCRIPTION**

| Sr. No | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Biosafety | Introduction and Development of Biosafety Practices<br>Principles<br>General lab requirements<br>Definitions and Biosafety levels: 1,2,3,4<br>Summery<br>Biological safety cabinets: centrifuges,<br>Shipment of biological specimens,<br>Biological waste management,<br>Decontamination, Biosafety manuals,<br>Medical surveillance, Emergency response | 18 |

| | | | |
|---|---|---|---|
| 2 | Bioethics | History and Introduction<br>Ethics and genetic engineering<br>Genetic Privacy<br>Patent of genes<br>Human races<br>Trading Human Life<br>Human Cloning<br>Stem Cells<br>Eugenics<br>Biotechnology and Christian faith<br>Human genome and religious considerations<br>Case Studies<br>Final Considerations | 16 |
| 3 | Intellectual Property Rights | Introduction<br>Types of Intellectual Property Rights<br>Plant and Animal growers rights<br>Patents<br>Trade secretes, Copyrights, Trademarks<br>IPR and plant genetic recourses<br>GATT and TRIPS and Dunkels Draft<br>Patenting of biological materials<br>International conventions and cooperation<br>Current Issues<br>Patents for higher animal and higher plants<br>Patenting of transgenic organisms and isolated genes<br>Patenting of genes and DNA sequences<br>Indian scenario. | 14 |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY**

The course will be covered through lectures. The students will be given problems and case histories to discuss and clear their problems. The students will be evaluated based on two class tests, lecture and lab attendance, class participation, write up and quizzes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Understanding Biotechnology by Borem
2 Biotechnology an Introduction: Barnum S.R.
3 Biosafety and Bioethics : Joshi
4 Introduction to Bioethics : Bryant
5 Legal Aspects of Business : Pathak
6 Intellectual Property Rights : Raju
7 Patent Law : Narayan
8 Intellectual Property Management: Jungham

**TITLE OF THE COURSE: GENOMICS**

| | |
|---|---|
| **COURSE CODE: BT-604** | **L T P Hr C** |
| **MARKS: 150** | **3 0 2 5 4** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in protein study and drug discovery.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of Genome organization and new techniques used in genomics that are PCR,DNA Chips, Sequencing.

**PREREQUISITES**

Since the course is very advance in nature, student must know about DNA different Forms of DNA, there structure and Basic separation and visualization techniques for nucleic acids.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction to Genomics. | History, What is genome, structural and organization of genome/ | 5 |
| 2 | DNA sequence determination | DNA Sequencing and its accuracy | 4 |
| 3 | Polymerase Chain Reaction | History ,use, application. | 4 |
| 4 | Genome Centers and their organization. | Gene order and its aplication | 2 |
| 5 | High-throughput DNA sequencing technology, robotics and automation.identification | Automated DNA sequencing | 3 |
| 6 | Potentials and limitations | Computing BAsics | 2 |

| | | | |
|---|---|---|---|
| | of existing software and hardware tools and their relationship with sequencing methods. | | |
| 7 | Genome analysis and annotation. | ESTs and Finding Function from sequence. | 4 |
| 8 | Phylogenetic analysis | Clustering methodology ,strategy, and its application | 7 |
| 9 | Internet resources. | Bioinformatics Useful sites:- ENSEMBL, TIGR, | 4 |
| 10 | Genomic mapping and single nucleotide polymorphism (SNP). | SNPs and its application | 3 |
| 11 | Micro array gene expression analysis. | Microarray Technique and analysis | 4 |
| 12 | Introduction to biological data modeling. | Homology modelling | 3 |
| 13 | Vocabulary and Foundations | | 3 |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**REFERENCES BOOKS:**


- Bioinformatics: A practical guide to analysis of genes and protein By Baseman's A., D & Ouellette B.F.F Wiley
- Bioinformatics Methods and Protocols (Methods in Molecular Biology, Vol. 132) by Stephen Misener (Editor), Stephen A. Krawetz (Editor
- Gene cloning IV by T.A. Brown, Genomes II T.A. Brown, cell biology

**PRACTICALS IN GENOMICS (4 Hrs.) MARKS : 100**

**OBJECTIVE:**

The objective of the course is to familiarize students with the basic principles and the advancement in the field of genome analysis and gene expression. The practical's intents to give students knowledge and hands on experience of genome expression analysis techniques.

**LEARNING OUTCOME:**

The students will have hands on knowledge of techniques of genome analysis, high throughput gene expression analysis by protein profiling, and its applications at the end of the course.

**PREREQUISITE:**

Students should have basic knowledge of molecular biology and Recombinant DNA techniques, cell biology and bioinformatics.

**LIST OF EXPERIMENTS:**

| Sr. No. | Name of practical | Hrs |
|---|---|---|
| 1 | Nested PCR | 4 |
| 2. | Multiplex PCR | 4 |
| 3. | Nucleotide sequencing | 4 |
| 4. | mRNA isolation | 4 |
| 5. | Reverse transcriptase ( RT) PCR | 4 |
| 6. | Real time PCR | 4 |
| 7. | Probe labeling by nick translation | 4 |
| 8. | in-vitro transcription | 4 |
| 9. | Isolation and characterization of Expressed Sequence Tag (ESTs) | 4 |
| 10. | Proteome analysis by 2D gel electrophoresis | 4 |
| 11. | BLAST analysis | 4 |
| 12. | Bioinformatics analysis of promoter, splice site, and termination site | 4 |

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**REFERENCE BOOKS :**

Molecular Cloning by Sambrook and Russel, practical manual,Cold Spring Harbor Lab. CSHL) Publication,2004 Vol I,II and III

**TITLE OF THE COURSE: C# .NET (ELECTIVE-II)**
**COURSE CODE: BI-606** **L T P Hr C**
**MARKS : 150** **3 0 2 5 4**

**OBJECTIVE:**
The objective of the course is to create understanding amongst the students in the subject of C# .Net through the practical and theory

**LEARNING OUTCOME:**
At the end of the semester, it is expected that students understood how to make Database & webpage designing, windows form design using C# .Net. It is expected that they will be more confident to use the aspects of C# .Net in pursuing their higher education or for Software Industries.

**COURSE DESCRIPTION:**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Introduction/ Overview of .Net | Introduction to .Net<br>Platform for the future<br>Drawbacks of Current Trend<br>Net Framework – BCL & CLR<br>l Key design goals<br>CLR, CTS, MSIL & other tools.<br>Multiple Language Interaction & support l Moving from Project to Assemblies…<br>Security in .NET – CAS<br>Advantages/Disadvantages<br>Features of .Net<br>Assemblies in Detail<br>GAC, Strong Names | 4 |
| 2 | Visual C#.Net Language | Advantages/Disadvantages<br>Why C#/ Why Not C#<br>Where does C# Fit in<br>C, C++ to Visual C# | 5 |

| | | | |
|---|---|---|---|
| | | Features of C<br>.NET Namespaces<br>.NET Versions – 1.1/2.0/3.0/3.5 Beta<br>Visual Studio.NET 2003/2005/Orcas/2008<br>Windows Vista – New Look Gadgets/SideBars/UAC – relation with .NET<br>Hardware/Software Requirements | |
| 3 | Programming Using Visual C#.Net | The start of the application<br>C#.Net Program Design<br>Variables and types<br>Value types and reference types (CTS)<br>Strings and arrays<br>The Console class<br>String formatting<br>Statements and flows<br>Programming Structures<br>Command-line arguments<br>VS.NET to Create C#.NET Apps<br>C# 3.0/3.5 features – Implicit types , Extention Methods and more | 5 |

| | | | |
|---|---|---|---|
| 4 | Introduction To Windows Form | Windows Forms – I<br>Windows forms library – WinForms<br>Layout Enhancements<br>Forms and controls – Hierarchy<br>Creating simple GUI by hand<br>Event handling<br>Basic controls<br>Windows forms – buttons, check boxes, radio buttons, panels, group boxes, list boxes, picture boxes…<br>Windows Forms – II<br>Menus<br>Built-in dialog boxes and printing<br>Extender Controls<br>ToolStrips, StatusStrips and progress bars<br>A new MDI forms strategy<br>Inheritance with forms<br>New Controls – Web Browser, Property Grid etc | 5 |
| 5 | Object Oriented Concepts (Basic) | Classes & objects<br>Abstract & override methods<br>Creating and using your own classes l Data members and member methods l Instantiate an object<br>This keyword<br>Properties – Read Only Write Only…<br>Build process using windows class library l Generate classes for other clients<br>How to use classes as part of project | 4 |
| 6 | Object Oriented | Accessibility levels, specifiers<br>Constructors | 6 |

| | | | |
|---|---|---|---|
| | Concepts (Advanced) | Method overloading<br>Class (static) variables & methods<br>Object destruction<br>'ref' and 'out' parameters<br>Constant values<br>Enumerations<br>Inheritance and Polymorphism<br>The root of all classes<br>Creating derived classes<br>Method overriding and hiding<br>Polymorphism and virtual functions<br>Casting objects<br>Abstract classes<br>Sealed classes<br>Static classes | |
| 7 | Error Handling | Unstructured error handling support<br>Structured error handling<br>Error categories<br>Debugging the application<br>Debug and Trace classes<br>Code Optimization<br>Testing and strategies | 4 |
| 8 | Ado.Net | Ado.Net Components<br>Data Sources And .Net Data Providers<br>Accessing Data In The Connected Environment<br>Accessing Data In Disconnected Environment<br>Sorting, Searching And Filtering | 7 |
| 8 | ASP.Net | Introduction to web technologies<br>Web Forms Architecture<br>ASP.Net and HTTP<br>Web application developing using Visual Studio | 8 |

| | | | |
|---|---|---|---|
| | | State Management and Web Applications<br>ASP.Net Server-side controls<br>Caching in ASP.Net<br>ASP.Net application configuration<br>Debugging, Diagnostics of application<br>Connectivity with Database using ADO.Net/Entity Framework<br>Data Access Controls<br>Personalization and Security | |
| **Total Lectures** | | | **48** |

**BOOKS RECOMMENDED:**

- C Sharp.Net Complete Reference, McGrawHill
- C# 2010 Programming: Author: Kogent Learning Solutions Inc. Publisher: Dreamtech Press
- Beginning ASP.NET 4.5 in C# and VB (Author :Imar Spaanjaars)
- C# and the .Net Platform (second edition ) by Andrew Troelsen, Aprèss publication.
- Beginning ASP.NET 3.5 in C# 2008 by Matthew MacDonald, Apress publication.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**PRACTICAL'S IN C#.NET (2 Hrs. Per Week)  MARKS : 50**

**LIST OF PRACTICAL'S**

1. Windows Form designing**.**
2. Windows Forms Layout
3. Windows forms – buttons, check boxes, radio buttons
4. Windows forms – panels
5. Windows forms – group boxes, list boxes.
6. Windows forms -picture
7. MySQL Database connectivity
8. Sql Server Database connectivity
9. Oracle Database connectivity
10. MS excel Database connectivity
11. MS access Database connectivity
12. Error Handling( based on the syllabus)
13. Oop's basic & advanced
    i. Creating classes,
    ii. Objects, passing values,
    iii. Creating method,
    iv. Method overloading,
    v. Method overriding,
    vi. Inheritance,
    vii. Abstract classes,
    viii. Static classes,
    ix. Constructors,
    x. Virtual functions.
14. Webpage designing. ( based on the syllabus)
15. Database designing( based on the syllabus)

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**Elective II (OLD)**

**TITLE OF THE COURSE: COMPUTER NETWORKING**

**COURSE CODE:BI-606** **L T P Hr C**

**MARKS: 200** **3 0 4 7 5**

## OBJECTIVE

1 To create general understanding regarding basic knowledge of networking in computers, which are the protocols used for transmission of data, devices used in networking.
2 To familiarize the student with the models used in networking like OSI model.
3 To increase the knowledge of student about cryptography, digital signatures, e-mails, etc.

## LEARNING OUTCOME

At the end of the course, the students will have sufficient understanding of the basic knowledge of networking in computers, which are the protocols used for transmission of data, devices used in networking, bit transmission, cryptography, etc.

## PREREQUISITES

Students should know the basics in networking like LAN, MAN, WAN concepts, HTML.

## COURSE DESCRIPTION

| Sr. No. | Topics | Detail Syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Introduction: | Uses of computer Networks<br>Network Hardware<br>Network Software<br>Reference Models<br>Network Examples<br>Network standardization | 06 |
| 2 | The Physical Layer | The theoretical basis for data communication<br>Guided transmission media<br>Wireless transmission | 06 |

| | | | |
|---|---|---|---|
| | | Communication satellites<br>The public switched telephone network<br>The mobile telephone system<br>Cable television. | |
| 3 | The data Link Layer: | Data link layer design issues<br>Error detection & correction<br>Elementary data link protocols<br>Sliding window protocols<br>Protocol verification<br>Examples of data link protocols | 06 |
| 4 | The medium access control sub-layer | The channel allocation problem<br>Multiple access protocol<br>Ethernet<br>Wireless LANs<br>Broadband wireless<br>Bluetooth<br>Data link layer switching | 06 |
| 5 | The network layer | Network layer design issues<br>Routing algorithms<br>Congestion control algorithms<br>Quality of service<br>Internetworking<br>The network layer in the Internet | 06 |
| 6 | The transport layer | The transport service<br>Elements of transport protocol<br>The internet transport protocols: UDP<br>The internet transport Protocol: TCP<br>Performance issues | 06 |
| 7 | The application layer | DNS- the domain name system<br>Electronic mail<br>The World Wide Web<br>Multimedia | 06 |

| | | | |
|---|---|---|---|
| 8 | Network Security | Cryptography<br>Symmetric key algorithms<br>Public key algorithms<br>Digital signatures<br>Management of public keys<br>Communication security<br>Authentication protocols<br>E-mail security<br>Web security<br>Social issues | 06 |
| | | **Total Lectures** | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes. The topics which are difficult & important will be given in the question bank, which is to be solving before the semester ending.

**Evaluation Scheme (Theory)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**:

1 Computer Networks by Andrew S. Tanenbaum

**Elective II**

**TITLE OF THE COURSE: OPERATING SYSTEM**

| **COURSE CODE: BI 504** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 200** | **3** | **0** | **2** | **5** | **4** |

**OBJECTIVE**

1 To create general understanding regarding basic knowledge of Operating system, concept of process, responsibilities of Operating System, management of disk, job scheduling etc.

2 To familiarize the student with Deadlock, Semaphores.

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient understanding of the Deadlock: prevention, Memory organization and management, Virtual memory concepts, paging and segmentation, address mapping, Overview of the Linux OS.

**PREREQUISITES**

Students should know the basics in Computer, what is operating system

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Overview | Operating systems,<br>Functionalities and characteristics of OS.<br>Hardware concepts related to OS, CPU states, I/O channels, memory hierarchy, microprogramming, Structure of Disk,<br>Disk Storage Allocation Schemes for File Allocation Table<br>The concept of Process, | 3 |

| | | | |
|---|---|---|---|
| | | operations on processes, process states, concurrent processes, process control block, process context | |
| 2 | File Systems Responsibilities of OS | File operations, attributes, extensions, types<br>Access Methods Directory Organization Single Level Two Level Tree Structured<br>Acyclic Graph Directory General Graph Directory Protection<br>Consistency Semantics File System Implementation<br>Management of Free Space Disk Scheduling Algorithms | 3 |
| 3 | History Using Windows OS | OS Features, capabilities, limitations<br>UNIX process control and management, PCB, signals, forks and pipes | 2 |
| 4 | operating system organization | Interrupt processing, operating system organization, OS kernel FLIH and Dispatcher<br>Job and processor scheduling, scheduling algorithms, process hierarchies<br>Problems of concurrent processes, critical sections, mutual exclusion synchronization, deadlock<br>Mutual exclusion, process co-operation, producer and consumer processes | 4 |
| 5 | Semaphores | definition, init, wait, signal operations<br>Use of semaphores to implement mutex, process synchronization implementation of semaphores | 3 |
| 6 | | Critical regions, Conditional Critical Regions, Monitors, Ada | 4 |

| | | | |
|---|---|---|---|
| | | Tasks.<br>Interprocess Communication (IPC), Message Passing, Direct and Indirect.<br>16.Deadlock: prevention, detection, avoidance, banker's algorithm | |
| 7 | Memory management | Memory organization and management, storage allocation<br>Virtual memory concepts, paging and segmentation, address mapping<br>Virtual storage management, page replacement strategies | 4 |
| 8 | File organization | blocking and buffering, file descriptor, directory structure<br>File and Directory structures, blocks and fragments, directory tree, inodes, file descriptors,<br>UNIX file structure | 4 |
| 9 | Overview of the Linux OS | History<br>Architecture Features and capabilities<br>Kernel, shell & applications<br>File System / Directory Structure<br>Multitasking and Multi-user system<br>Operating modes ( RC scripts, Init levels) | 4 |
| 10 | Important concepts in a Linux environment | Login<br>Login scripts & profiles<br>X window system, the GUI under Linux<br>Different window manager<br>Linux Installation<br>Linux Shell Programming Vi Text Editor, Shell Variables Examples<br>Piping and redirection<br>copy, rename, delete and move | 5 |

| | | | |
|---|---|---|---|
| | | directory listing, file handling and IO redirection | |
| 11 | Users and Groups | Concept of users and groups<br>Owner creator<br>Primary and secondary group<br>types of file and directory permission | 3 |
| 12 | Basic commands and using GUI | Miscellaneous other commands cat, cal, date, passwd, less, grep, wc, bc uname, etc<br>KDE<br>Editors (Kwrite, Kedit)<br>Office Applications (word processors, spreadsheets)<br>Internet related applications (browsers, mail , clients)<br>Multimedia applications | 4 |
| 13 | Command Line Interface | Additional text manipulation commands. e.g. cut, grep, split, paste, basename and various other gnu utils etc.<br>Working with bash<br>Login scripts and profiles<br>Shell scripting<br>Introduction to regular expressions<br>Process management | 4 |
| 14 | Trouble Shooting | Tips and Tricks<br>Getting help<br>In silico viruses | 1 |
| | | **Total Lecture** | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial

classes. There will be two class tests/ and surprise test conducted during the tutorial classes. The topics which are difficult & important will be given in the question bank, which is to be solve before the semester ending.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Introduction to Parallel Computing Second Edition by Grama et al. Addison-Wesley, Inc., 2003, ISBN 0-201-64865-2.
2 Modern Operating Systems (second edition), Andrew S. Tanenbaum, Prentice Hall Publishers, 2001, ISBN 0-13-031358-0.
3 William Stallings, Operasting Systems, Prentice Hall.
4 Harvey M. Deitel, An introduction to operating systems. Addison-Wesley.
5 Andrew Tanenbaum & Albert Woodhull, Operating Systems: Design and Implementation.Prentice-Hall.
6 Douglas Comer, Operating System Design - The XINU Approach. Prentice-Hall.
7 A.M. Lister, Fundamentals of Operating Systems. Macmillan (1979

**PRACTICAL'S IN OPERATING SYSTEM (2 Hrs. Per Week)**

**MARKS: 50**

**LIST OF PRACTICAL'S**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**Elective II**

**TITLE OF COURSE : PERL AND BIOPERL**

| **COURSE CODE: BI 603** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 150** | **3** | **0** | **2** | **5** | **4** |

**COURSE CONTENT:**

1. **Introduction and Installation:** 4
   - Introduction to perl
   - Use of Perl in Bioinformatics
   - History, Availability, Support and Basic Concepts

2**. Scalar Data:** 4
   - Number, ,String, Scalar Operators, Scalar Variables
   - Scalar Operators, Functions

3. **Arrays and List Data:** 4
   - Introduction, Literal Representation, Variables
   - Array Operators and Functions, Scalar and List context

4. **Control Structure**: 4
   - Data types: Arithmetic and logical operators
   - Conditions and loops

5. **Hashes:** 4
   - Hash variables, Literal Representation of hashes, Hash function

6. **Basic I/O:** 4

7. **Regular Expressions:** 4
   - Use of regular expression, , Patterns, Matching operators
   - Substitution, Split and Join functions

8. **Subroutine**: 4
   - System and user function, The local Operator
   - Variable length Parameter list

9. **Advanced features in Perl:** 4
   - Advanced features in Perl, Advanced functions, operators files and directories

- System Interaction, Using Perl's command line tool.
- References and Structures, Using Modules

10. **Using Perl for CGI** 6

11. **Using Bioperl Modules** 6

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**

- Solutions & Examples for Perl Programmers by Nathan Torkington and Tom Chistiansen.
- Network Programming with Perl($1^{st}$ edition) by Lincoln Stein.
- Beginning Perl for Bioinformatics by James Tisdall,O-Reilly
- Developing Bioinformatics Computer Skills by Cynthia Gibas, Per Jamberk, O-Reilly
- Developing Bioinformatics Computer Skills by Cynthia Gibas, Per Jamberk,O-Reily
- Learning Perl by Randal
- Programming Perl by Larry Wall
- Programming the Perl DBI by Alligator Descartes
- Advanced Perl Programming

**PRACTICAL'S IN PERL AND BIOPERL (2 Hrs. Per Week)**

**MARKS: 50**

**LIST OF PRACTICAL'S**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

| SEMESTER VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 701 | Biomembrane and Molecular Cell Signaling | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 705 | Development of Biology and Stem Cells | 3 | 1 | 0 | 4 | 4 | 100 |
| HU 701 | Quality Control Management in Biotechnology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 706 | Transcriptomics | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 603 | Biochemical Engineering | 3 | 1 | 4 | 8 | 3 | 200 |
| BT 707 / BT 708 / BT 709 / BT 710 | Elective-III | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **3** | **8** | **27** | **25** | **900** |

**Elective III:**
**BT 707 : Metabolic Engineering**
**BT 708 : Marine Biotechnology**
**BT 709 : Agricultural Biotechnology**

**TITLE OF THE COURSE: BIOMEMBRANES AND MOLECULAR CELL SIGNALING**

**COURSE CODE: BT 701** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the interactions between cells, the pathways and mechanisms of cellular communications.

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of the cellular receptors, their types and their role in cell-cell interactions.

**PREREQUISITES:**

Since the course is an advanced level course, the student should have sufficient knowledge of enzymes, receptors, cellular transport and its machinery.

**COURSE DESCRIPTION:**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Overview of cell-cell and intracellular signaling mechanisms | Endocrine transmissions, Paracrine transmissions, Autocrine transmissions, Synaptic transmissions | 01 |
| 2 | Cell-cell recognition | Molecules involved in recognition, their functions and the mechanisms of recognition. | 02 |
| 3 | Cell-adhesion molecules | CAMs, their properties and types. | 02 |

| | | | |
|---|---|---|---|
| 4 | Concepts of receptors (extracellular, intracellular): | Receptor ligand interactions (concepts of agonist and antagonist)<br>Receptor characterizations<br>Receptor functions<br>Extra cellular receptors<br>Coupling of Receptors to different signal transducing machinery | 07 |
| 5 | G-proteins | Structure and their function | 02 |
| 6 | Ion channels and catalytic proteins | Justification of the large nature of the genome, genome complexity, tandem repeats, micro and mini satellites. | 04 |
| 7 | Adenylate cyclase system | cAMP-PK and CREB proteins | 04 |
| 8 | Calcium channels | Types of calcium channels, their structure, location and mechanism of transport. | 02 |
| 9 | Oscillations of calcium concentration as signals | Consequence of low and high calcium concentrations in the cell and its effects. | 03 |
| 10 | Receptors with protein tyrosine kinase activity | Structure and function | 02 |
| 11 | Intercellular receptors | Steroid receptors, structure and function | 02 |
| 12 | Second messengers | Phosphoinositides, inositol1,4,5, tris phosphate, diacyl glycerol, camp, cGMP, arachidonic acid, prostaglandins and NO | 06 |
| 13 | Mechanism(s) of | Coupling of activation receptors | 06 |

| | | | |
|---|---|---|---|
| | signal transduction | to intracellular signal transducing machinery; protein kinase(s) cascade | |
| 14 | Receptor modifications, adaptation of cells. | Different structural and functional modifications in the receptors. Cellular adaptations. | 02 |
| 15 | Developmental abnormalities due to defective signaling pathways | Abnormalities during growth and development. | 01 |
| 16 | Signal transducing machinery as targets for potential drugs | Different molecules in cell signaling, action of drugs on them. | 02 |
| | | **Total number of Lectures** | **48** |

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

1 Genes VII by Lewin and Benjamin
2 Molecular cell biology by Lodish, Baltimore
3 Molecular Biology of the cell by Bruce Alberts

**New Course in Development Biology & Stem Cells for M. Tech. Biotechnology replace with previous course Stem Cell**

**TITLE OF THE COURSE: DEVELOPMENTAL BIOLOGY AND STEM CELLS**

**COURSE CODE: BT 705** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in stem cell biology

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of different types of stem cells and new techniques used in stem cell biology.

**PREREQUISITES**

Since the course is very advance in nature, student must know about cell-cell interaction and cell signaling. Student must have background with cell biology.

**COURSE DESCRIPTION**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| | **Developmental Biology** | | |
| 1 | Introduction to Developmental Biology | Origins and History**,** Early Beliefs Gametogenesis, Fertilization, Mechanisms of Preventing Polyspermy, Fertilized-Egg, Activation | 4 |
| 2 | Cleavage | Mechanisms of Cleavage, | 4 |

| | | | |
|---|---|---|---|
| | | Cleavage Patterns, Holoblastic, Cleavage: Isolecithal and Mesolecithal; Meroblastic Cleavage: Telolecithal and Centrolecithal; Cleavage Patterns in Major Groups of Organisms; Cell Specification | |
| 3 | Gastrulation | Cell Movements, Germ Layers, Gastrulation in Major Groups of Organisms | 4 |
| 4 | Later Embryonic Development | The Central Nervous System (CNS) and Epidermis, Mesoderm, Endoderm differentiation, Cell Death, Front Limb vs. Hind Limb Formation | 4 |
| 5 | Genetic basis of Development | Differential Gene Expression and various developmental stages, Genetic Knockouts | 3 |
| | **Stem cells** | | |
| 6 | Stem cell basics | Stem cell terminology<br>Stem Cells from Early Mammalian Embryos<br>Introduction to ES cells, EC cells, EG cells and TS cells. Their origin and characteristics. | 4 |
| 7 | Embryonic Stem cells | Isolation of ES cells<br>Salient features of ES cells<br>Application of ES cells. | 3 |
| 8 | Germline Stem Cells | Types of GSC's.<br>GSC's in mammals, Drosophila and C. elegans.<br>Establishment of GSC's | 4 |

| | | | |
|---|---|---|---|
| | | Stem cell niche. | |
| 9 | Stem Cells and Cloning | Therapeutic and reproductive cloning<br>Nuclear Transfer method<br>Application of NT ES cells.<br>Safety of NT ES cells. | 3 |
| 10 | Bone Marrow Mesenchymal Stem Cells | History<br>Embryonic origin of MSC's<br>Harvesting, Isolation and Characterization.<br>Differentiation studies of MSC's | 4 |
| 11 | Hematopoietic Stem Cells | Identfication of HSC's<br>Characterisation of HSC's<br>Mouse HSC's assay- In vitro and In vivo | 4 |
| 12 | Neurons, Stem Cells, and Potential Therapies | Neural stem cell<br>Neural crest stem cell<br>Alternative source for neural precursor | 3 |
| 13 | Stem cell applications | Role in cancer and other diseases<br>Ethical and Regulatory aspects of stem cell technology<br>Role of Stem Cells in Cell signaling | 4 |
| **Total number of Lectures** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Developmental Biology, Eighth Edition, Scott F. Gilbert, Susan Singer, Publisher: Sinauer Associates Inc.; ISBN-13: 978-0878932504
2. Developmental Biology: A Very Short Introduction, Lewis Wolpert, Publisher: Oxford University, ISBN-13: 978-0199601196
3. Essential Developmental Biology, Jonathan M. W. Slack Publisher: Wiley-Blackwell; 3 edition, ISBN-13: 978-0470923511
4. Stem cell handbook, by STEWART SELL, MD
5. Stem cell Biology by Robert Lanza.

**TITLE OF THE COURSE: QUALITY CONTROL MANAGEMENT IN BIOTECHNOLOGY**

**COURSE CODE: HU 701** **L T P Hr C**

**MARKS: 100** **3 1 0 4 4**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to prepare students competent in the field of quality control management of drugs and biopharmaceutical. The aim of the course is to create a general motivation amongst students to critically analyze the problem and how to apply the knowledge of quality management in their future endeavor. To prepare them to think independently for making newer project through literature survey, writing a review article on a topic and 15 min. presentation to the class.

**LEARNING OUTCOME**

At the end of the semester it is expected that student understood the basics of quality control management practice in the industry and research labs., It is expected that they will be more confident to develop and implement the same policies in their research projects either for pursuing their higher education or for industrial application

**PREREQUISITE**

This is an advance level course. Students must have an understanding of introduction chemistry, Biology, Biochemistry , Microbiology, Pharmacology and toxicology of drugs, plant and animal biology,

**COURSE DESCRIPTIONS:**

| Sr. No. | Topic | Description | Hrs |
|---|---|---|---|
| 1 | Introduction | General introduction about drugs manufacturing process and policies | 2 |
| 2 | TQM | Details of the total quality management. | 2 |
| 3 | Industrial standard | ISO 9000 series, ISO 140000 series | 3 |
| 4 | Pharmacopeias | Indian Pharmacopeias, British | 1 |

| | | | |
|---|---|---|---|
| | | Pharmacopeias<br>US Pharmacopeias, Extra Pharmacopeias | |
| 5 | Good manufacturing processes | Introduction<br>GMP and CGMP, GXP and GCP | 3 |
| 6 | Key requirement of C GMP | C GMP for API manufacturing<br>Quality management, Personel<br>Building and facilities, Documentation<br>Material management, Production and Inprocess control<br>Packaging Storage and distribution<br>Laboratory control Validation, Change control<br>Rejection and reuse of material, Complaints and recall<br>Contract manufacturers, Agents, Brokers, Traders, Distributors, Repacker and retailer | 15 |
| 7 | Good Laboratory Practices | History, Present Status<br>Indian scenario | 4 |
| 8 | ICH | ICH guidelines<br>History and Introduction, Necessity of ICH<br>International scenario and Indian scenario | 4 |
| 9 | SOP | Standard operating procedures | 2 |
| 10 | MVP | Master Validation Plan in labs and industry | 2 |
| 11 | Accredition & Registration with various Regulatory Authorities | National Accreditition Board for Testing & Calbbration(NABL)<br>Registration with FDa of other countries for expoting formulations, API & NCE's. | 2 |
| Total number of Lectures | | | 45 |

**METHODOLOGY**

The course would be covered through lectures, supported by quizzes and case history discussion. A visit to pharma industry after the study will help their understanding om the sinkect. The students will be evaluated based pm twp c;ass test, lecture attendance, class participation, Write-up and power point presentation.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1 Quality control assurance Anjaneyulu
2 Pharmaceutical management by Itkar
3 Pharmaceutical master validation plan by Haider
4 Handhook of microbiological Quality Control by Baird.

**TITLE OF THE COURSE: TRANSCRIPTOMICS**

| **COURSE CODE: BT-706** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE**:

Objective of the course is to familiarize the students with basic principles and the advancement in the field of genome and gene expression analysis. The course also introduces the students to various techniques of gene expression profiling in prokaryotes and eukaryotes.

**LEARNING OUTCOME:**

The students will have knowledge of high throughput methods of genome analysis and gene expression profiling at the end of the course.

**PREREQUISITE**:

Students should have basic knowledge of molecular biology of transcription in prokaryotes and eukaryotes, recombinant DNA technology, cell biology and bioinformatics.

**COURSE DESCRIPTION**:

| **Sr. No.** | **Topics** | **Detail** | **Hrs** |
|---|---|---|---|
| 1. | Introduction | Concepts of transcriptomics and its scope.<br>Transcription and post-transcriptional modifications.<br>Differential gene expression.<br>RNA splicing/xport<br>RNA stability<br>Translational control ( miRNA) | 2<br>3<br><br>3 |

| | | | |
|---|---|---|---|
| 2. | Tools and Techniques for transcriptome analysis | Global expression profiling and expression analysis by DNA microarray,cDNA microarray, Gene chip synthesis spotted array and in - situ hybridizarion of oligonucleotides<br>Gene chips for transcriptional profiling in human, mouse, plant, yeast, bacteria etc.<br>Human brain transcriptome.<br>Yeast meiotic transcriptome<br>Expressed sequence tags (ESTs) and sampling of ESTs from cDNA libraries. ESTs database.<br>Serial Analysis of gene expression (SAGE).<br>Massively parallel signature sequencing (MPSS) | 6<br><br><br>4<br>2<br>2<br><br>4<br><br>2<br>2 |
| 3. | Applications in expression profiling in human diseases | Gene chips for disease profiling. Identification of novel tumor supressor genes, insulin resistance, and asthma.<br>Expression profiling for class prediction and class discovery in similar types of cancer. | 7 |
| 4. | Introduction to Bioinfomatic tools and internet resources | Gene expression omnibus (GEO).<br>Center for information Biology Gene Expression Database (CIBEX).<br>EPCLUST programme.Microarray and gene expression (MAGE).<br>MGED ( Microarray gene expression database)<br>Bioinformatic analysis of promoter prediction, splice site termination site. | 6<br><br><br><br><br>3 |
| | | Total | 46 |

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**REFERENCES BOOKS :**


1. Transcriptomics: Expression pattern analysis by Virendra Gomase and Somnath Tagore,VDM Verlag.2009

2. Genome Transcriptome and Proteome Analysis by Alain Bernot, John Wiley and Sons Ltd.2004

3. Principles of gene manipulation and Genomics S.B.Primrose and R.M Twymann, Blackwell publishing, VII edition, 2006

4.Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbour Laboratory Press ( CSHLP),II edition,2004

**PRACTICALS IN TRANSCRIPTOMICS (4 Hrs.)**

**MARKS : 100**

**OBJECTIVE**:

The objective of the course is to familiarize students with the basic principles and the advancement in the field of genome analysis and gene expression. The practicals intents to give students knowledge and hands on experience of genome expression analysis techniques.

**LEARNING OUTCOME:**

The students will have hands on knowledge of techniques of genome analysis, high throughput gene expression analysis by protein profiling, and its applications at the end of the course.

**PREREQUISITE**:

Students should have basic knowledge of molecular biology and Recombinant DNA techniques, cell biology and bioinformatics.

| Sr. No. | Name of practical | Hrs |
|---|---|---|
| **1.** | Nucleotide sequencing | **4** |
| **2.** | Nested PCR | **4** |
| **3.** | Multiplex PCR | **4** |
| **4.** | mRNA isolation | **4** |
| **5.** | Reverse transcriptase ( RT) PCR | **4** |
| **6..** | Nucleic acid labeling by nick translation | **4** |
| **7.** | in -vitro transcription | **4** |
| **8.** | Size fractionation of RNA using denaturing agarose gel electrophoresis. | **4** |
| **9.** | Differential gene expression by real time PCR | **4*** |
| **10.** | PCR-based Method for Detection and Quantification of Small RNAs (SnRNA) | **4** |
| **11.** | Isolation and characterization of Expressed Sequence | **4*** |

| | | |
|---|---|---|
| | Tag (ESTs) | |
| **12.** | Proteome analysis by 2D gel electrophoresis | **4*** |
| **13** | Nucleotide and amino acid sequence analysis by using bioinformatic tools. | **4*** |

*The time allotted in the syllabus is as per slot given for each practical. It can be adjusted according to the respective practical requirement.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**TITLE OF THE COURSE: BIOCHEMICAL ENGINEERING**
**COURSE CODE BT - 603 L T P Hr C**
**MARKS: 200 3 1 4 8 6**

**OBJECTIVE:**
The objective of the course is to create general understanding amongst the students in the subject of Biochemical Engineering through in-depth lectures. The objective of the course is create an understanding of concepts and basic principles in the subject with emphasis on how to apply the knowledge in industrial processes involving Biochemical Engineering.

**LEARNING OUTCOME:**
At the end of the semester, it is expected that students understood the basic principles of engineering knowledge to solve a critical industrial biotechnology problem. It is expected that they will be more confident to use the knowledge in pursuing the knowledge in production of useful metabolites.

**PRE-REQUISITES:**
This is an introductory level course. Students are expected to have an understanding of introductory knowledge in Physics, Chemistry and Biology.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of lectures** |
|---|---|---|---|
| 1 | Introduction to Biochemical Engineering | -Fundamentals of biochemical engineering<br>-Biotechnology and Bioprocess engineering | 2 |
| 2 | Stoichiometry & Energetic | -Principles of thermodynamics<br>-Stoichiometry for metabolic pathways: Carbon metabolism, biosynthesis of | 6 |

| | | | |
|---|---|---|---|
| | | molecules, Stoichiometry of cell growth and product synthesis, theoretical predictions of yield coefficients with examples | |
| 3 | Bioprocess Kinetics | Reactors for measurement of Kinetics, Structured Kinetic Models, Balanced and transient growth kinetics, Kinetics of product formation, Death kinetics during fermentation process | 6 |
| 4 | Biological reactors | Ideal & non-ideal bioreactors, reactor operations: Batch, Fed-batch & Continuous. Growth, Substrate utilization and Product formation: Mass & Heat Balances, Structured and unstructured models<br>Bioreactor design & configurations, microbial reactors- aerobic and anaerobic reactors, Immobilized enzyme & cell reactor systems, Animal cell culture systems | 8 |
| 5 | Transfer reactions | Mass transfer concepts in Gas-liquid systems, mass transfer across free surface, KLa and oxygen transfer rate, rheology and its relation to mass transfer, non-Newtonian fluids, factors affecting Kla, heat transfer correlations | 8 |
| 6 | Bioreactors: Operation and control | Sensors for measurement of different parameters, on-line sensing and measurement systems, computational methods, data analysis during process, Process control: regulatory and cascade, continuous and advanced systems | 7 |
| 7 | Scale up, process economics and applications | Consideration of parameters for scale up, process economics: one example from laboratory to market and economic considerations, mathematical modeling of one system like anaerobic digester and simulation studies | 6 |
| 8 | Case Studies | Case studies (Product or technology | 5 |

| | | | |
|---|---|---|---|
| | | based)<br>- Microbial system<br>- Animal system<br>- Recent developments | |
| | **Total** | | **48** |

**METHODOLOGY:**

The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED**


1 P. F. Stanbury, A. Whitaker and S. J. Hall. 'Principles of Fermentation Technology', Pergamon Press, Oxford and revised editions.1995.

2 J. E. Bailey, D. F. Ollis Biochemical Engineering Fundamentals, 2nd edition, McGraw-Hill, New. York) and revised editions. 1986

3 Pauline Doran, Bioprocess Engineering Principles, Academic Press (1995) and revised editions.

4 Shuler, ML and F. Kargi. Bioprocess. Engineering: Basic Concepts (Second Ed.). Prentice Hall, Englewood Cliffs, NJ. 2002.

**PRACTICALS IN BIOCHEMICAL ENGINEERING**
**(4 Hrs. Per Week) MARKS : 100**

**LIST OF PRACTICALS**

1. Study of bioreactor design in laboratory.
2. Microbial Growth kinetics: Determination of specific growth rate (μ), Saturation constant (KS) and growth yield (Yx/S), Sp. product formation rate (Q1) and substrate consumption rate for the given microorganism in batch culture.
3. Study of Growth curve by optical density method. Determination of cell dry mass, and its co-relation with N for E.coli/S.cerevisiae.
4. Determination of KLa by sulphite oxidation method.
5. Control of bioreactor and operation of biosensors for the control of pH, temperature, aeration and agitation rate in the bioreactor.
6. Determination of thermal death point and thermal death time for E. coli and for Saccharomyces cerevisiae.
7. Disruption of microbial cells (Baker's yeast) for the release of the intracellular proteins.
8. Immobilization of enzyme for demonstration of biological activity and immobilization efficiency.
9. Study of rheology of fermentation broth. Determination of viscosity and Packed cell volume (PCV)
10. Estimation of substrate consumption rate in fermenter batch based on glucose concentration in the broth.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**Elective III**

**TITLE OF THE COURSE: METABOLIC ENGINEERING**

| **COURSE CODE: BT 707** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient scientific understanding of the different biotechnological methods

**PREREQUISITES:**

Since the course is an advanced level course, the student should have sufficient knowledge

**COURSE DESCRIPTION:**

| **Sr. No.** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| 1 | Course Description | Learning the basic biochemical concepts of metabolic pathways<br>Understanding the role of Bioinformatics in the study of metabolic pathways<br>Learning the Bioinformatics-based approaches for predicting and engineering metabolic pathways<br>Classification of Enzymes<br>Classification of Metabolic Pathways | 15 |
| 2 | Metabolic Pathway database | KEGG, EMP<br>Malaria Parasite Metabolic Pathways<br>ECoCYC aetaCyc<br>Boerhringer Mannheim- Biochemical Pathways | 15 |

| | | | |
|---|---|---|---|
| 3 | Enzymes, Compounds and Reaction databases | LIGAND-Biochemical Compound and Reaction<br>ENZYME-Enzymes<br>BRENDA- Comprehensive Enzyme Information System<br>Full Genome Annotation through knowledge of Metabolic Pathways<br>Organism Specific Metabolic Pathways,<br>Comparison of Metabolic Pathways,<br>Engineering of Metabolic pathways,<br>Representation of Metabolic Pathways<br>Generation and Dynamic Representation of Metabolic Pathways Knowledge<br>Deriving Common Principles from the Metabolic Pathways knowledge | 15 |
| | | **Total number of Lectures** | **45** |

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Metabolic engineering edited by Sang Yup Lee and Eleftherious T. Papoutsakis
2. Metabolic engineering - Principles and Mehodologies by Gregory N. Stephanopoulos, Aristos A. Ariostidou and Jens Nielsen.

**Elective III**

**PRACTICAL IN METABOLIC ENGINEERING (4 Hrs.)**

**MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**Elective III**

**TITLE OF THE COURSE: MARINE BIOTECHNOLOGY**

| **COURSE CODE: BT 708** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **4** | **7** | **5** |

**COURSE DESCRIPTION:**

1. Introduction
2. Aquaculture/Aquacrops
    - Gasrtopod,Bivalve & Crustacean Production
3. Marine Animal Health
4. Algal Products
5. Fuels from Algae
6. Algal Cell Culture
7. Medical Application
    - Marine Natural Products & their medical potential
    - Anticancer and Antiviral Compounds
    - Antibacterial Agents
    - Marine Toxins
8. Probing the Marine Environment
9. Conservation
10. Terrestrial Agriculture
11. Transgenic Fish
12. Future of Marine Biotechnology

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


- Micro Algae : Biotechnology & Microbiology,E.W.Becker Cambridge University Press.
- Aqua Culture – An Introduction, Lee & Newman, Interstate Publishers
- Biotechnology an Introduction, Susan R.Barnum, Vikas Publishing House

**Elective III**

**PRACTICAL IN MARINE BIOTECHNOLOGY (4 Hrs.)**

**MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**Elective III**

**TITLE OF THE COURSE: AGRICULTURAL BIOTECHNOLOGY**

| **COURSE CODE : BT 709** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS : 200** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with basic concepts and advanced molecular biology applications in Agriculture Biotechnology

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of different biotechnological methods to improve the crop production and sustainable agriculture.

**PREREQUISITES**

The course is an application science, hence the student must have a background with knowledge in the basics of Plant Physiology, Plant Tissue culture and Molecular Biology.

**COURSE DESCRIPTION:**

| **Sr. No.** | **Perticulars** | **Hrs.** |
|---|---|---|
| 1. | Introduction: Agriculture and Agricultural Biotechnology | 2 |
| 2 | Clonal Germplasm<br>• Micro propagation<br>• In vitro production of pathogen and contaminant free plants | <br>4<br>3 |
| 3 | Biotechnology- Methods of Crop Improvement<br>• Genetic Engineering of Crop Plants | 3<br>3 |

| | | |
|---|---|---|
| 4 | Transgenic Plants<br>Molecular Markers<br>QTL Mapping | 4<br>3<br>3 |
| 5 | Metabolite Production<br>• Production of Secondary Metabolites<br>• Production of foreign compounds in transgenic plants | 5 |
| 6 | Biofertilizers and Bioremediation<br>• Microbial Biopesticides , Biofungicides, Herbicides and Agricultural antibiotics | 7 |
| 7 | Biotechnology in Agriculture<br>• Ethical Aspects and Public Acceptance | 3 |
| 8 | Animal farming, Animal farming with organic concept, Animal Breeding & Genetically modified animal products. | 5 |
| | **TOTAL** | **45** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practical.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOK RECOMMENDED:**

- Biotechnology by B. D. Singh, Kalyani Publication
- Biotechnology – Fundamentals and applications by S. S. Purohit, Student Edition
- Agricultural Biotechnology-Arie Altman, CRC Press
- Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House

**PRACTICALS IN AGRICULTURE BIOTECHNOLOGY**
**(4 Hrs. Per Week) MARKS: 100**

**LIST OF PRACTICALS**

1. Use of bioreactors in plant secondary metabolite production
2. Application of Polymerase Chain reaction – Marker based selection by using PCR
3. Agro-bacterium-mediated transformation protocol and selection of transformed regenerated plants (Laboratory visit)
4. Visit to micro-propagation and Molecular Biology laboratory - a laboratory with automated Genotyping/sequencing facility.
5. Green house technology: Visit to functional green house. Climate: Measurement of temperature, humidity, air velocity, CO2, inside the green house. Calculation of environment indices inside green house. Fertigation, Post harvest.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

## SEMESTER VIII

| Sr. No. | PROJECT | CREDITS |
|---|---|---|
| 1 | Industrial Posting or Research | **25** |
| 2 | Project Preparation | |
| 3 | Monthly review of the work | |
| 4 | End Semester Evaluation of the Project report and Presentation and Viva voce | |

| SEMESTER VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **Hr** | **Cr** | **Marks** |
| BT 801 | Protein Modeling and Drug Designing | 3 | 0 | 4 | 7 | 5 | 200 |
| BT 802 | Proteomics | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 505 | Biomedical Engineering | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 803 | Nanobiotechnology | 3 | 0 | 2 | 5 | 4 | 150 |
| BT 804 | Seminars in Biotechnology & Advances in Biotechnology | 3 | 1 | 0 | 4 | 4 | 100 |
| BT 805 / BT 710 | Elective – IV | 3 | 0 | 4 | 7 | 5 | 200 |
| **Total** | | **18** | **2** | **12** | **32** | **26** | **900** |
| **Elective III (BT 805: Clinical Research / BT 710 : Biopharmaceuticals)** | | | | | | | |

**TITLE OF THE COURSE: PROTEIN MODELING AND DRUG DESIGNING**

| **COURSE CODE: BT 801** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **1** | **4** | **8** | **6** |

**OBJECTIVE**

1. To create general understanding regarding basic principles involved in modern medicinal/structural chemistry systems.
2. To familiarize the student with basic concepts in molecular modeling as: how to build the molecule, how to find out the coordinates of the molecule, how to use the programs that are available in graphics designing.
3. To familiarize students with concepts in molecular mechanics and dynamics and to study the energy minimization algorithms
4. To introduce them to concepts in quantum chemistry and methods for calculating the energies, that are required in energy minimization and docking studies
5. To understand the methodology involved in structure based drug designing, and enzyme inhibition strategies

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in classical and modern molecular modeling and drug designing, concepts and laws applicable to quantum-mechanics particles. This would enable him to understand the entire concepts in computerized drug designing and interaction concepts

**PREREQUISITES:-**

This is an introductory course for the students who want to understand the concepts in molecular modeling and drug designing and should make a compulsory subject

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Introduction to molecular graphics: | • Cartesian, and crystal coordinate system,<br>• Reducing molecular coordinates to fit Computer monitor<br>• Basic principle of molecular graphics and structure visualization<br>• Small molecular structural data bases (Chembridge data base)<br>• Protein structural data base (PDB)<br>• Different molecular graphics packages, Graphics Programs: HAMOG, RASMOL,MOLMOL | 08 |
| 2 | Building of small molecules | • Building of small molecules<br>• Internal and cylindrical polar co-ordinate system<br>• Methods used in building small molecules using crystal, Cartesian, polar and chemical internal coordinates.<br>• Building of Biopolymers DNA & oligopeptides in different secondary structure | 10 |
| 3 | Optimization of geometries of small molecules: | • Energy minimization by systematic search method<br>• plotting conformation energy contours (Ramachandran plot), and finding out minimum energy conformation | 10 |

| | | | |
|---|---|---|---|
| | | • Gradient based Energy minimization methods<br>• Molecular mechanics approach<br>• Molecular Dynamics method<br>• Monte Carlo method<br>• Genetic algorithm | |
| 4 | Use of Quantum chemical methods for geometry optimization: | • Schrödinger equation<br>• Basic Formalism in quantum mechanics<br>• Schrödinger equation for a multi- electron atom<br>• Schrödinger equation for a molecule<br>• Hartree- Fock Method<br>• Different MO methods<br>• Molecular electrostatic potential<br>• Optimization of geometries of small molecules<br>• Quantum chemical indices | 10 |
| 5 | Drug designing | • Pharmacophore identification and novel drug designing, structure based drug design enzyme inhibition strategies | 06 |
| **Total Lectures** | | | **36** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a student's is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


1. Molecular Modeling, Holtje and Folkers G Weinheim New York
2. Essentials of Drug designing, V. Kothekar Dhruv Publications 2005
3. Molecular modeling: principles and applications, Leach.A.R
4. Molecular modelling and drug design, Andrew Vinter A.and Gardner, M Boca Raton: CRC Press, 1994

**PRACTICAL IN PROTEIN MODELING AND DRUG DESIGNING (2 Hrs .per week) MARKS 50**

The course will also have a practical component. The practical training would be in the area of building molecules drawing molecules visualizing the Diffraction Grating: Use of diffraction grafting for determination of wavelength of spectral lining.

**BUILDING MOLECULES**

- glycine
- glycine-glycine
- alanine
- glycine-alanine
- phenylalanine
- benzene
- SPDBV
- calculate the electrostatic potential using spdbv software
- analysis of Ramachandran plot using spdbv software

HYPERCHEM

- Use of molecular modeling software HYPERCHEM for building small molecules.
- Computation of quantum chemical parameters using HYPERCHEM
- Creating database for small molecular indices using HYPERCHEM

**MOE**

- Use of molecular modeling software MOE for building small molecules
- Use of molecular modeling software MOE for building oligopeptides and oligonucleotides
- Computation of force field parameters using MOE
- Computation of conformation map of a small molecule using MOE
- Optimization of geometries of small molecules using MOE
- Creating database for small molecular indices using MOE

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**TITLE OF THE COURSE: PROTEOMICS**

**COURSE CODE : BI 708** **L T P Hr C**

**MARKS: 100** **3 0 0 3 3**

**OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with advanced research area and basic concept in protein study and drug discovery**.**

**LEARNING OUTCOME**

At the end of the course, the students will have sufficient scientific understanding of proteins to proteomics and new techniques used in proteomics that are MALDI-TOF, 2DE, NMR, ESI and various databases SCOP, CATH, PIR etc.

**PREREQUISITES**

Since the course is very advance in nature, student must know about Protein structure 20 different amino acids, there structure and Basic separation and visualization techniques for nucleic acids.

**COURSE DESCRIPTION**

| **Sr. No** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| **1** | General introduction to the proteomics. | History, What is proteome, structural of amino acids in protein physiological complexity of genome/proteome? | **5** |
| **2** | 2D gel electrophoresis data, mass spectrometry and protein characterization | What is 2D-PAGE, protein microarrey-MALDI-TOF, NMR, ESI, Affinity chromatography protein protein interaction, m-RNA splicing. | **7** |
| **3** | ESTs, sequence dependent properties of proteins, and post translational modifications Protein folding and evolution. | Expressed Sequence Tags, Amino acid structure, Acylation , Methylation, Alkylation etc | **8** |

| | | | |
|---|---|---|---|
| **4** | Hierarchical nature of Protein Structure | Pri,sec,ter,quat structure,,Ramchandran plot | **6** |
| **5** | Fold classification and identification | SCOP | **7** |
| **6** | 3D structure of protein and its relation to function | Protein structure prediction and its application. | **7** |
| **7** | Computational resources Internet tools | NCBI,EMBL,PDB,Ensembl | **8** |
| **Total lectures,** | | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

- Protein to proteomics by J. Simpson,Genomes II T.A. Brown,Protein Structure by Brandent & Tooz
- Bioinformatics A practical guide to analysis of genes and protein By Baxevanis A. D & Ouellette B.F.F Wiley
- Developing Bioinformatics Computer Skills by Cynthia Gibas, Per Jambeck (Paperback)
- Bioinformatics Methods and Protocols (Methods in Molecular Biology, Vol 132) by Stephen Misener (Editor), Stephen A. Krawetz (Editor)
- Bioinformatics Basics Applications in Biological Science and Medicine by Hooman H. Rashidi, Lukas K. Buehler

**TITLE OF THE COURSE: BIOMEDICAL ENGINEERING**

**COURSE CODE: BT 505 L T P Hr C**

**MARKS: 100 3 1 0 4 4**

**OBJECTIVE**

Biomedical engineering integrates physical, chemical, mathematical, and computational sciences and engineering principles to study biology, medicine, behavior, and health. It advances fundamental concepts; creates knowledge from the molecular to the organ systems levels; and develops innovative biologics, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis, and treatment of disease, for patient rehabilitation, and for improving health.

**LEARNING OUTCOME**

The students will be able to apply knowledge of mathematics, science, and engineering to design a system, component, or process to meet desired biotechnology needs. They will be able to develop a biomedical product considering realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

**PREREQUISITES**

Understanding of animal physiology, physics, engineering and biochemistry is a prerequisite.

**COURSE DESCRIPTION**

| Sr. No. | Topics | Detail syllabus | No. of Lectures |
|---|---|---|---|
| 1 | Introduction | -History of Biomedical engineering<br>-Integration of biology, biochemistry, and engineering to | 02 |

| | | | |
|---|---|---|---|
| | | create new biomedical products<br>-Biomimicry and its role in biomedicine | |
| 2 | Biomedical Instrumentation | -Regular optical methods and imaging systems, electro-mechanical probes<br>-Bioelectric amplifiers<br>-Patient monitoring systems<br>-Impedance techniques in physiological measurements | 06 |
| 3 | Diagnostic equipments | - Blood Flow meters<br>- Pulmonary function analyzers<br>- Blood gas analyzers<br>-Cell counters<br>- Endoscopy<br>-Biophysical activity of organs<br>-Electrical simulation, ultrasonic waves, magnetic waves in diagnosis and therapy<br>- Robotics in diagnosis and therapy | 07 |
| 4 | Tissue Biomechanics | - Biological processes in tissue organization (molecular, cellular, extracellular, and organ levels of hierarchy)<br>- scaling laws (architectural) and continuum mechanics with respect to material properties of tissues and their organization | 06 |
| 5 | Biomaterials | -Molecular and structural properties of biological materials like collagen, silk, bone, protein adhesives, self-assembling peptides | 07 |

| | | | |
|---|---|---|---|
| | | -Molecular structural properties of biomaterials of microbial, plant or other natural origin<br>- Methods for biomaterials surface characterization; matrix synthesis, degradation, and contraction<br>-materials science and cell biology principles for the design of medical implants, artificial organs, and matrices for tissue engineering<br>-artificial organs | |
| 6 | Regenerative medicine | -Principles of organ regeneration<br>-Implants and their coherence with biological systems/biocompatibility<br>-Biological processes involved in wound healing and tissue remodeling following implantation in various organs<br>-Examples of biomaterials in regeneration in tissues, bone, orthodental, optical systems, cardiovascular devices, cochlear implants, etc<br>-Challenges and ethical issues | 08 |
| 7 | Drug delivery systems | - Principles of Controlled Drug Delivery, controlled release devices, Biomaterials in drug delivery<br>- Biomaterial based drug delivery system efficacy and challenges | 03 |
| 8 | Biosensors | -Components and properties of a | 07 |

| | | | |
|---|---|---|---|
| | | typical biosensor<br>-Types of biosensors (Calorimetric, Potentiomentric, amperometric, optical, Piezo-electric, Immuno based sensors)<br>-Representative design of each type of biosensor<br>-Biomarkers and their role in development of medical biosensors<br>- Applications related to healthcare, bio-defense and food and water safety | |
| | Personalized medicine | -Concept and applications<br>- Concerns and market response | 02 |
| **Total Lectures** | | | **48** |

**METHODOLOGY**

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**RECOMMENDED BOOKS:**


1. J B Park, Biomaterials - Science and Engineering, Plenum Press , 1984.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. D N Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982
4. Khandpur R S, Handbook of Medical Instrumentation, Tata Mc Graw Hill
5. D. L. Wise , "Applied Bio Sensors", Butterworth, London.
6. Cromwell, Weibell & Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India
7. Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
8. Robbinson C.J., Rehabilitation Engineering. CRC press 1995
9. Weiss, Thomas Fischer. Cellular biophysics. Cambridge, Mass., MIT Press.
10. Peter J. Carrington, John Scott and Stanley Wasserman, eds., Models and Methods in Social Network Analysis Cambridge University Press, 2005

**COURSE NAME: NANOBIOTECHNOLOGY**

| **COURSE CODE: BT 803** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS : 150** | **3** | **0** | **2** | **5** | **4** |

**OBJECTIVE:**

The objective of the course is to create general understanding amongst the students in the subject of Core nanotechnology and its applied parts such as nanobiotechnology and bionanotechnology through in-depth lectures & laboratory practicals. The objective of the course is to understand them a general overview, concepts and basic principles in the subject of nanobiotechnology with emphasis for project in the field of nanotechnology.

**LEARNING OUTCOME:**

At the end of the semester, it is expected that students understood the basic principles of core nanotechnology and bionanotechnology. It is expected that they will be more confident to use the basic knowledge for their short term projects during the semesters.

**PRE-REQUISITES:**

This is an advanced level course. Students are expected to have an understanding of introductory knowledge in Physical science, material science, polymer science, micro-fabrication, organic and synthetic chemistry and molecular biology.

**COURSE DESCRIPTION**

| **S. No** | **Topic** | **Description** | **Hrs** |
|---|---|---|---|
| **1** | **Introduction and Basics** | • Introduction<br>• Definition of Nanotechnology, nanobiotechnology and bionanotechnology<br>• Nanotechnology and Today'sWorld | **2** |

| | | | |
|---|---|---|---|
| | | • Importance of Nanoscale Science and Technology | |
| **2.** | **History and Evolution** | • Contribution of Different Scientist in Nanotechnology<br>o Richard Feynman<br>o K. Eric Drexler<br>o Gerd Binnig and Heinrich Rohrer<br>o Don Eigler and Erhard Schweizer<br>o Professor Richard Smalley<br>• Different Timelines of Nanotechnology development | **4** |
| **3** | **Nanoparticles and nanomaterials** | • Introduction<br>• Types of nanoparticles<br>o Pure metals :Gold, Silicon, Silver, Cobalt<br>o Metal oxides: Silica, Zinc oxide, Iron oxideAlumina, Titania<br>• Properties of nanomaterial and nanomaterial<br>• Toxic effects of nanomaterials<br>• Significance of nanoparticles | **6** |
| **4** | **Synthesis of nanoparticles** | • Bottom up and Top down approach<br>• Chemical methods: Gas phase and liquid phase synthesis<br>• Chemical precipitation and co precipitation | **8** |

| | | | |
|---|---|---|---|
| | | • Metal nanocyrstals by reductions, sol-gel synthesis<br>• Microemulsion or Reverse micelle<br>• Solvothermal synthesis<br>• Thermolysis route<br>• Sonochemical synthesis<br>• Electrochemical synthesis<br>• Biological methods<br>• Synthesis of nanoparticles by using bacteria, yeast, fungi, and actinomycetes, plant extract. | |
| **5** | **Nanotubes and Nanocomposites** | • Introduction and studies in carbon nanotubes<br>• Chemistry of carbon nanotubes<br>• Types of carbon nanotubes<br>• Introduction to nanocomposites<br>• Polymers used as matrix for nanocomposites | **6** |
| **6** | **Biomaterials** | • Introduction and historical background<br>• First generation biomaterials Metal & metal alloys, Ceramics, Polymers, Composites<br>• Second generation biomaterials Biodegradable polymers, Hydrogels,<br>• Third generation biomaterials | **5** |

| | | | |
|---|---|---|---|
| | | Biomaterials in tissue engineering | |
| **7** | **Nanostructures and nanodevices** | • Liposomes<br>• Niosomes<br>• Micelle and reverse micelle<br>• Quantum dots<br>• Nanosphres and microspheres<br>• Nanopowder<br>• Nanowires and Nanorods<br>• Nanoshells<br>• Dendrimers | **6** |
| **8** | **Applications of Nanobiotechnology** | • Nanotechnology in medicine<br>• Drug delivery<br>• Gene delivery<br>• Drug encapsulation<br>• Nanopharmacology<br>• Nanocapsule and Medibots<br>• Tissue repair and implantation<br>• Bioresorable materials<br>• Biochips<br>• Environmental Management | **8** |
| | | **Total Lecture** | **45** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**


- Bionanotechnolgy: Lesson from Nature, David S. Goodsell, Willey-Liss, First edition, 2004
- Nanoscale technology in Biological Systems by Ralph Creco, Fritz Prinz and R. Lane Smith; CRC Press, First edition, 2005.
- Nanobiotechnology: Concepts, applications and Perspectives, Christof M. Niemeyer (editor), Clad AMirkin (Editor), Wiley VCH, First edition, 2004.
- Nanobiotechnology: Bioinspired Devices and Material of Future by OdedShoseyov and Ilan levy, Human Press, First edition, 2007.
- Nanobiotechnology protocols (Methods in Molecular biology) by Sandra J Rosenthal David W. Wright, Human Press, First edition, 2005
- The Nanobiotechnology Handbook, YubingXie, CRC press,
- Introduction to Nanoscience, S.M. Lindsay, Oxford universal Press, First Edition, 2010
- Nanotechnology: Understanding small system, Ben Rogers, SumitaPennathur and Jesse Adams, CRC Press, Second edition, 2011
- Introduction to Nanotechnology, Charles Poole and Frank Owen, Wiley, First Edition, 2006
- Nanocomposites Science and Technology Pulickel M. Ajayan, Linda Schadler, Paul Braun, Wiley-VCH Verlag, 2003.

**PRACTICAL IN NANOBIOTECHNOLOGY (2 Hrs.)**

**MARKS : 50**

**PRACTICAL COURSE:**

1. Preparation of silver nanoparticles by chemical methods.
2. Characterisation of ZnS nanoparticles by optical methods.
3. Templeted synthesis of $Fe_3O_4$ nanoparticles.
4. Synthesis of ZnS nanoparticle by using bacteria.
5. Biological synthesis of silver nanoparticles using plant extract.
6. Study of antimicrobial activity of silver nanoparticles.
7. Protein tagging of nanoparticles.
8. Internalization of nanoparticles in mammalian cells.
9. Synthesis of quantum dots.
10. Drug attachment to nanoparticles.
11. DNA attachment to nanoparticles.

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 15 |
| Continuous Assessment | | 05 |
| End semester Exam Viva & Spotting | 2.5 hours | 30 |
| **Total** | | **50** |

**COURSE NAME: SEMINARS IN BIOTECHNOLOGY AND ADVANCES IN BIOTECHNOLOGY**

| **COURSE CODE: BT 804** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **0** | **3** | **3** |

**OBJECTIVE OF THE COURSE:**

In view of the increasing knowledge in the field of biotechnology student should be made aware of the latest advancements in biotechnology.

**LEARNING OUTCOME:**

After the presentation the student get trained in performing literature survey and presenting a scientific paper.

**METHODOLOGY:**

Student will be presenting the seminar every week as per the schedule and will be assessed by the experts.

**COURSE DESCRIPTION**

Advanced topics will be taught by outside experts and senior faculty of the institute. The student will be assigned one Seminar on any advanced topic of Biotechnology.

**EVALUATION METHODOLOGY:**

The student seminars will be assessed for evaluation

**Elective IV**

**TITLE OF THE COURSE: BIOPHARMACEUTICALS**

| **COURSE CODE: BT 710** | **L** | **T** | **P** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **4** | **7** | **5** |

**OBJECTIVE OF THE COURSE:**

To create general understanding regarding basic knowledge of Biopharmaceuticals to familiarize the student with the production techniques, mode of action and therapeutic uses of Biopharmaceuticals.

**LEARNING OUTCOME:**

At the end of the course, the students will have sufficient understanding of the current status of Biopharmaceuticals.

**PREREQUISITES**

Students should know the basics of Microbiology, Biochemistry.

**COURSE DESCRIPTION**

| **Sr. No.** | **Topics** | **Detail syllabus** | **No. of Lectures** |
|---|---|---|---|
| 1 | Overview | Introduction and current status of Biopharmaceuticals in the pharmaceutical industry<br>How are Biopharmaceuticals different from Pharma ceutical products | 4 |
| 2 | The drug manufact uring process | Good Manufacturing Practices, Source of Biopharmaceuticals, production, analysis and immunological approaches for the detection of contaminants in the final product. | 6 |

| | | | |
|---|---|---|---|
| 3. | Hormones of therapeutical interest | Insulin, Insulin receptors, production of human insulin by rDNA technology, insulin formulation, Glucagon, Human growth factors(hCG) – biological effect, recombinant hCG- production and uses, Gonadotrophins, FSH , LH. | 6 |
| 3 | Blood Products and Therapeutic Enzymes | Blood cells, blood substitutes, serum protein isolation, haemostatic, coagulation pathway, blood factor isolation for transfusion, anticoagulants, thrombolytic agents, enzymes of therapeutical value | 6 |
| 5 | Growth Factors | Growth factors and wound healing, Insulin like growth factors (IGFs)-biochemistry, receptors, binding proteins, biological effects, IGFII and effect on fetus development and reproduction neuronal, Epidermal growth factor (EGF), Platelet derived growth factors (PDGF). | 6 |
| 6. | Haemopoietic growth factors | Erythropoietin (EPO) - receptors, transduction regulation therapeutic applications. | 4 |
| 7. | Antibodies, vaccines and adjutants | Polyclonal antibodies, Monoclonal antibodies and their production by hybridoma technology, applications of Monoclonal antibodies<br>Vaccine Technology, traditional vaccine production, impact of genetic engineering on vaccine technology, Vaccine adjuvant. | 4 |

| | | | |
|---|---|---|---|
| 8 | Nucleic acid therapeutics | Basic approach to gene therapy, vectors used in gene therapy, manufacturing plasmid DNA, antisense technology, and ribozymes. | 4 |
| 9 | Cytokines, Interleukins and Interferon | Biological effects, biochemistry, production and therapeutic applications | 5 |
| | | Total lectures | 45 |

**METHODOLOGY**

The course would be taught through lectures, demonstrations and practicals.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**BOOKS RECOMMENDED:**

1. Biopharmaceuticals- Biochemistry and Biotechnology. Second Ed. Garry Walsh. John Wiley and Sons. 2003

**PRACTICALS IN BIOPHARMACEUTICALS**
**(4 Hrs. Per Week)** **MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

**(Elective IV)**

**TITLE OF COURSE: CLINICAL RESEARCH**

| **COURSE CODE MT 806** | **L** | **T** | **H** | **Hr** | **C** |
|---|---|---|---|---|---|
| **MARKS: 100** | **3** | **0** | **0** | **3** | **3** |

**OBJECTIVE OF COURSE:**

The primary objective of this course is to familiarize the students about higher educational areas after their graduation. The course also aware students about current situation of clinical research in India and future for clinical research in India topics required for clinical research establishment.

**LEARNING OUTCOME:**

At the end of the course students should be able to understand various disciplines in the field of clinical research and it will help them for selecting their dissertation in final year.

**PREREQUISITE:**

No prerequisite is required for the course.

**COURSE DESCRIPTION:**

| **Sr. No.** | **Topic** | **No. of Lectures** |
|---|---|---|
| **1** | Introduction | 02 |
| **2** | History | 01 |
| **3** | Drug development process | 01 |
| **4** | GLP and GCP in clinical research | 02 |
| **5** | ICH in relation to clinical research | 02 |
| **6** | SOP in clinical research trials | 01 |
| **7** | Basic terminology in CR | 02 |
| **8** | Ethical theories and principles | 03 |
| **9** | Ethics committees | 01 |
| **10** | Audits and inspection in CR | 02 |

| | | |
|---|---|---|
| **11** | FDA audit- role of investigators and sponsors | 03 |
| **12** | FDA protecting consumers and protecting public health | 02 |
| **13** | Role of biostatistics in CR | 02 |
| **14** | Clinical trial protocol design and development | 02 |
| **15** | Data base closure | 01 |
| **16** | Data cleaning | 01 |
| **17** | Designing case report forms (CRF) | 02 |
| **18** | EMEA European Medicines Agency | 02 |
| **19** | EMEA committees | 02 |
| **20** | Fraud and misconduct in CR | 02 |
| **21** | INDA(Investigational new drug application) and NDA (New drug application) | 04 |
| **22** | Informed consent process | 01 |
| **23** | Medical writing | 01 |
| **24** | Pharmacoepidemiology | 01 |
| **25** | Pharmacovigilance | 01 |
| **26** | Schedule Y and its application | 01 |
| **27** | Project management | 02 |
| **28** | Current status of CR in India | 01 |
| **TOTAL LECTURES** | | **48** |

**METHODOLOGY**

The course would be taught through lectures, demonstrations.

**EVALUATION SCHEME (THEORY)**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| I Internal | 45 minutes | 15 |
| II Internal | 45 minutes | 15 |
| Teachers assessment | | 10 |
| End Semester Exam | 2 hours 30 minutes | 60 |
| **Total** | | **100** |

**PRACTICALS IN CLINICAL RESEARCH (4 Hrs. Per Week)**

**MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

| **Examination** | **Duration** | **Marks** |
|---|---|---|
| Minor test 1 | 1 hour | 30 |
| Continuous Assessment | | 10 |
| End semester Exam Viva & Spotting | 2.5 hours | 60 |
| **Total** | | **100** |

## SEMESTER IX & X

| SR. NO. | PROJECT | CREDITS |
|---|---|---|
| 1 | Industrial Posting or Research | **50** |
| 2 | Project Preparation | |
| 3 | Monthly review of the work | |
| 4 | End Semester Evaluation of the Project report and Presentation and Viva voce | |