



**DPU**

**Dr. D. Y. PATIL VIDYAPEETH, PUNE**  
(DEEMED UNIVERSITY)

**SYLLABUS**  
**FOR**  
**B. TECH BIOTECHNOLOGY**

**2014-15**

## COURSE STRUCTURE FOR B. TECH 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
<b>Total</b>		<b>18</b>	<b>3</b>	<b>12</b>	<b>33</b>	<b>27</b>	<b>1000</b>
<i>BS - Basic Sciences, HU - Humanity, BT - Biotechnology, BI - Bioinformatics</i>							
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
<b>Total</b>		<b>18</b>	<b>2</b>	<b>12</b>	<b>32</b>	<b>26</b>	<b>900</b>
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
<b>Total</b>		<b>18</b>	<b>3</b>	<b>12</b>	<b>33</b>	<b>27</b>	<b>900</b>

<b>SEMESTER IV</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
BT 401	Molecular Biology-I	3	0	4	7	5	200
BT 402	Metabolism	3	1	0	4	4	100
BT 408	Animal Tissue Cultures & Stem Cells	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
<b>Total</b>		<b>18</b>	<b>4</b>	<b>14</b>	<b>33</b>	<b>26</b>	<b>950</b>
<b>SEMESTER V</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
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
<b>Total</b>		<b>18</b>	<b>2</b>	<b>16</b>	<b>36</b>	<b>28</b>	<b>1000</b>
<b>Elective I (BT 506 : Food Biotechnology / BT 507 : Environmental Biotechnology)</b>							
<b>SEMESTER VI</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
BT 601	Virology	3	1	0	4	4	100
HU 601	Principles of Managements & Entrepreneurial Development	3	0	0	3	3	100
HU 602	Bio safety and Bioethics & IPR	3	1	0	4	4	100
BT 602	Genomics, Transcriptomics & Proteomics	3	1	2	6	5	150

BT 603	Biochemical Engineering	3	0	4	7	5	200
BI 504 / BI 606 / BI 603	Elective-II	3	0	2	5	4	150
<b>Total</b>		<b>18</b>	<b>3</b>	<b>8</b>	<b>29</b>	<b>25</b>	<b>800</b>
<b>Elective II (BI 504: Operating System / BI 603:Perl &amp; Bioperl / BI 606:Computer Networking)</b>							
<b>SEMESTER VII</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
BT 701	Biomembrane and Molecular Cell Signaling	3	1	0	4	4	100
BT 702	Nanobiotechnology & Biosensors	3	0	4	7	5	200
HU 701	Quality Control Management in Biotechnology	3	1	0	4	4	100
BT 703	Advances in Biotechnology	3	0	0	3	3	100
BT 704	Seminars in Biotechnology	3	1	0	4	4	100
BT 707 / BT 708 / BT 709 / BT 710	Elective-III	3	0	4	7	5	200
<b>Total</b>		<b>18</b>	<b>3</b>	<b>8</b>	<b>27</b>	<b>25</b>	<b>800</b>
<b>Elective III (BT 707: Metabolic Engineering / BT 708 : Marine Biotechnology / BT 709 : Agricultural Biotechnology / BT 710 : Biopharmaceuticals)</b>							
<b>SEMESTER VIII</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
	Project					<b>25</b>	<b>400</b>

**COURSE STRUCTURE FOR B. TECH BIOTECHNOLOGY**

<b>SEMESTER I</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
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
<b>Total</b>		<b>18</b>	<b>3</b>	<b>12</b>	<b>33</b>	<b>27</b>	<b>1000</b>
<i>BS - Basic Sciences, HU - Humanity, BT - Biotechnology, BI - Bioinformatics</i>							

**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, Constructive & 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 its 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 turbulent flow, Reynold's number, Stoke's law, Terminal velocity, Determination of ' $\eta$ ' by falling sphere method.	07
4	Elasticity	Stress and Strain, Hook's law, Stress-strain curve, Young's	03

		modulus, Determination of Young's modulus.	
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. Introduction to crystal structure, Unit cell, seven crystal systems. Plank's Quantum Theory, Properties of Photon, Photoelectric effect, wave particle duality of radiation, de Broglie's hypothesis, Heisenberg's Uncertainty principle.	07
<b>Total Lectures</b>			<b>45</b>



## **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 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **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]
- Fundamentals 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 grating 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessm		10
Major test at the end of semester	3 hours	25
<b>Total</b>		<b>50</b>

**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**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 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, Pyrimidines (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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **BOOKS RECOMMENDED:**

- Organic Chemistry (6<sup>th</sup> Edition, 1992)- Robert Thornton Morrison and Robert Neilson Boyd (Prentice Hall)
- Organic Chemistry Vol. I and II and III by I. L Finnar. 5<sup>th</sup> 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  $\text{Cu}^{2+}$  from brass
8. Estimation of %q of  $\text{NH}_4\text{Cl} + \text{BaSO}_4$  gravimetric analysis
9. Preparation of Std.  $\text{K}_2\text{Cr}_2\text{O}_7$  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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		20
Major test at the end of semester	3 hours	50
<b>Total</b>		<b>100</b>

**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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Lectures Required</b>
1	Algebra : 1.1 Logarithms 1.1.1 Definition of Logarithm (Natural and common logarithm 1.1.2 Laws of Logarithm.	02
	1.2 Binomial Theorem: 1.2.1 Definition of factorial notation, permutation & combinations. 1.2.2 Binomial Theorem for positive index. 1.2.3 General term, middle term 1.2.4 Binomial theorem for any index 1.2.5 Binomial Theorem for Approximation.	04

2	<p>Trigonometry :</p> <p>2.1 Trigonometric Ratios (t-ratios)</p> <p>2.1.1 t-ratios of any angle, Relation between t-ratios, Fundamental identities.</p> <p>2.1.2 Relation between degree &amp; radian, T-ratios of std. angles.</p> <p>2.1.3 Quadrants sign of T-ratios in various quadrants, T-ratios of negative angles.</p>	03
	<p>2.2 T-ratios of Allied, Compound, Multiple and Submultiples angles.</p> <p>2.2.1 T-ratios of Allied angles.</p> <p>2.2.2 T-ratios compound angles.</p> <p>2.2.3 T-ratios of multiple &amp; sub-multiple angles.</p> <p>2.2.4 Factorization formulae</p> <p>2.2.5 Defactorization formulae.</p>	08
	<p>2.3 Inverse Trigonometric Functions.</p> <p>2.3.1 Definition of Inverse t-functions.</p> <p>2.3.2 Principle value of inverse t-functions.</p>	02
3	<p>Function and Limit</p> <p>3.1 Function :</p> <p>3.1.1 Definitions of variable, constant, intervals such as open, closed, semi-open etc.</p> <p>3.1.2 Definitions of function, value of function, domain &amp; range of a function.</p>	02
	<p>3.2 Limits :</p> <p>3.2.1 Concepts and definition of Limit.</p> <p>3.2.2 Limits of algebraic functions.</p> <p>3.2.3 Limits of trigonometric functions.</p> <p>3.2.4 Limits of exponential functions.</p>	06



	3.2.5 Limits of logarithmic function.	
4	Derivatives 4.1 Derivatives : 4.1.1 Definition of Derivatives, notations. 4.1.2 Rules of Derivatives (without proof) 4.1.3 Derivatives of composite functions. 4.1.4 Derivatives of Inverse trigonometric function by substitution method. 4.1.5 Derivatives of Implicit functions. 4.1.6 Logarithmic differentiation. 4.1.7 Second order differentiation.	06
	4.2 Application of Derivatives 4.2.1 Geometrical meaning of the derivatives. 4.2.2 Equations of Tangent & normal to the given curve. 4.2.3 Maxima & Minima.	04
5	5.1. Integration : 5.1.1 Definition of integration, Integration of Standard function; Rules of Integration. 5.1.2 Integration of rationale functions; Trigonometric functions to determine constant of Integration,	03
	5.2. Definite Integration: 5.2.1 Definition of Definite integral, definite. 5.2.2 Definite integral with simple problems.	02
	5.3. Application of Definite Integrals 5.3.1 Area under the curves. 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: i) Variable separable type. ii) reducible to variable separable form iii) Exact D.E.	

	iv) Linear D.E 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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 Vidayapeeth, 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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
	<b>Electronics</b>		
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, subtracter, 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	Microprocessor	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
<b>Instrumentation</b>			
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, pO <sub>2</sub> and pCO <sub>2</sub> 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
<b>Total Number of Lectures</b>			<b>45</b>

### **METHODOLOGY**

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

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **BOOKS RECOMMENDED:**

1. Digital Electronics by R. K. Jain Jain, Tata Mc Graw Hill, 3<sup>rd</sup> Edition, 2003.
2. Grob's Basic Electronics – Mitchel E. Schultz., Tata McGraw Hill, 10<sup>th</sup> Edition 2006.
3. Principals of electronics By V. K. Mehta , S. Chand Publisher , 1<sup>st</sup> Edition , 2010.
4. Op Amps and linear integrated circuits By Ramakant Gaikwad, McGraw –Hill publishing company limited, 4<sup>th</sup> Edition, 2002.
5. Integrated Electronics By Millman and Halkias. Mcgraw-Hill, 3<sup>rd</sup> Edition 1972 .
6. The Z 80 Microprocessor By Ramesh Gaonkar,. Penram Publisher , 3<sup>rd</sup> 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**

<b>Sr. No.</b>	<b>Name of the Practical</b>	<b>Time (Hrs.)</b>
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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
Major test at the end of semester	2.5 hours	30
<b>Total</b>		<b>50</b>

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

**COURSE CODE: BI 101**

**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 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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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). Compiler & 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 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	5
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
<b>Total Number of Lectures</b>			<b>46</b>

### **METHODOLOGY**

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

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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 :**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
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 communications, Use of good	02

		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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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 :**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
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 Stakeholders	
4	Inter-relationship between Disasters and Development	Factor affecting Vulnerabilities, differential impacts, impact of Development project such as dams, embankments, changes in Land-use 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)**



<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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

<b>SEMESTER II</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
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
<b>Total</b>		<b>18</b>	<b>2</b>	<b>12</b>	<b>32</b>	<b>26</b>	<b>900</b>

**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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
1	Basic concepts and principles	1. Osmosis- Diffusion, Osmotic Pressure, Theories of Osmosis. 2. Dialysis-Introduction, Technique, reverse dialysis, Glass fiber dialysis. 3. Viscosity –Introduction & Types of viscometer. 4. Colloids-Lyophilic & Lyophobic sols, Optical properties, Electrical properties of sols, Gold number. Donnan Equilibrium. 5. Phase rule-Phase, Components & Degree of freedom .Derivation of Phase rule. Phase diagram. Water system. 6. Acid-bases- Three concepts of acids & bases, P <sup>H</sup> meter & types of electrodes	2 2 3 3 5 3

		,Buffer solution, Acid base indicator , Law of mass action, Numerical. 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. 2. Atomic orbital's-Atomic orbital theory, Hybrid orbital's (sp, sp <sup>2</sup> , sp <sup>3</sup> ), molecular orbital theory. 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 energy phosphates compounds. Chemical equilibrium constant, Nernst equation.	3 3 7
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. 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. 3. Tracer technique-Advantages & limitations, Labeling procedures. 4. Use of Isotopes-Tritium, Carbon-13, Nitrogen-15,Oxygen -18,Carbon-14, Sodium-24, Phosphorus-32, Sulphur-35.	4 6 3 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)**

<b>Examination</b>	<b>Duration</b>	
<b>Marks</b>		
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **BOOKS RECOMMENDED:**

- Physical Chemistry by Atkins Peter and Paula Julio De 7<sup>th</sup> 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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Introduction to bio-molecules	Functional groups, 3D (three dimensional) structure, geometric and stereo-specificity.	4
2	Carbohydrates	Classification and stereochemistry, Structural properties, functional importance of storage and transport of structural polysaccharides: sucrose, starch, glycogen, cellulose, pectin,	6

		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, 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. Structural stabilization of proteins Protein function.	15
6	Nucleic Acids	Nitrogen bases: nucleosides and nucleotides. Historical basis of DNA structure Fibre X-ray diffraction and single crystal X-ray diffraction study on DNA A,B & Z form of DNA Local distortion in DNA structure Structure of Nucleosome Structure of RNA Properties of nucleic acids	10
Total number of lectures			48

## **METHODOLOGY**

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

## **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **BOOKS RECOMMENDED:**

- Text Book of Biochemistry by Nelson and Cox
- Biochemistry By Lubert Stryer Edn 3<sup>rd</sup>, 4<sup>th</sup>, and 5<sup>th</sup>.
- 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  $\lambda_{\max}$  & 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		20
Major test at the end of semester	3 hours	50
<b>Total</b>		<b>100</b>

**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 twelfth level they should have cleared the core mathematics in the first semester.

**COURSE DESCRIPTION**

<b>Sr. No.</b>	<b>Topics</b>	<b>Lectures Required</b>
1	Determinant & Matrices : 1.2 Determinant 1.2.1 Definition & expansion of determinant of order 2 and 3 1.2.2 Cramer's rule to solve simultaneous equations in 2 and 3 unknowns.	04

	<p>1.2 Matrices:</p> <p>1.2.1 Definition of Matrix of order <math>m \times n</math> and types of Matrices.</p> <p>1.2.2 Algebra of Matrices.</p> <p>1.2.3 Transpose of a Matrix</p> <p>1.2.4 Minor &amp; cofactor of an element of a matrix</p> <p>1.2.5 Adjoin of a Matrix.</p> <p>1.2.6 Inverse of a Matrix by adjoin method</p> <p>1.2.7 Solution of simultaneous equations containing 2 and 2 unknowns by Matrix inversion method.</p>	10
2	<p>Complex Number :</p> <p>2.1 Definition of Complex number, Cartesian, polar, exponential forms of complex number.</p> <p>2.2 Algebra of Complex Number</p> <p>2.3 De - Moivre's theorem (without proof) and simple problems.</p> <p>2.4 Euler's form of circular functions, Hyperbolic functions and relations between circular hyperbolic functions.</p>	04
3	<p>3.1 Numerical Solution of Algebraic Equations :</p> <p>3.1.1 Bisection Method</p> <p>3.1.2 Regula – Falsi Method</p> <p>3.1.3 Newton-Rophson Method</p>	06
	<p>3.2 Numerical Solution of Simultaneous Equations :</p> <p>3.2.1 Gauss elimination method.</p> <p>3.2.2 Iterative Methods Gauss Seidal and Jacobi's Method.</p>	04
	<p>3.3 Numerical Methods :</p> <p>3.3.1 Solution of Linear &amp; Non-Linear equation by i) Trapezoidal Rule ii) Simpson's Rule</p>	02
4	<p>Set Theory and Probability</p> <p>4.1 Set Theory</p> <p>4.2 Probability :</p> <p>4.2.1 Definition of random experiments, sample space, events, occurrence of event and types of events.</p> <p>4.2.2 Definition of probability, addition and multiplication theorem of probability.</p>	04

	4.3 Probability Distribution 4.3.1 Binominal Distribution. 4.3.2 Poisson's Distribution. 4.3.3 Normal Distribution.	04
5	Statistics 5.1 Frequency Distribution : 5.2 Measures of Control tendency (For Raw, Ungroup & group Data) 5.2.1 Mean 5.2.2 Median 5.2.3 Mode	01 04
	5.3 Measures of Dispersion 5.3.1 Raue, Variance, Coefficient of Cariance. 5.3.2 Standard Derivation.	01
6	Correlation & Regression	
	6.1 Correlation 6.2 Regression	01 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
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. 17<sup>th</sup> 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 Press 1989
- 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:**

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

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

**METHODOLOGY:**

The course would be taught through lectures, demonstrations and practicals

**EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
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" 2<sup>nd</sup> 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 ", 3<sup>rd</sup> Edition, Prentice- Hall of India Pvt.Ltd., 1993.
5. Timoshenko and Young, "Engineering Mechanics ", 4<sup>th</sup> Edition, McGraw Hill, 1995.
6. M cLean, "Engineering Mechanics' ", 3<sup>rd</sup> 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:**

<b>Sr. No.</b>	<b>Name of the practical</b>	<b>Time (Hrs)</b>
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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
Major test at the end of semester	3 hours	30
<b>Total</b>		<b>100</b>

**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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Introduction to C	An overview of C C expressions Operators	2
2	Data types:	Integers long and short Integers, signed and unsigned Chars, signed and unsigned Floats and doubles	2
3	The Decision controls in C:	The 'if' statements within <i>if</i> Multiple statements within <i>if</i> The ' <i>if-else</i> ' statement The ! operator Hierarchy of Logical Operators The Conditional Operators	4
4	Loop control structures:	Loops, The ' <i>While</i> ' Loop, The ' <i>for</i> ' loop Nesting of Loops Multiple Initializations in the for loop The ' <i>Odd</i> ' Loop, The ' <i>break</i> ' statement	5

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

11	Structures, Union, Enumeration & type definition:	Structures Arrays of structures Passing structures to functions Structure Pointers Unions Bit-Fields Enumerations 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
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 4<sup>th</sup> 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 Ritchie

**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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	3 hours	60
<b>Total</b>		<b>100</b>

**COURSE CODE: BS 204**

**COURSE NAME: ENVIRONMENTAL SCIENCE**

**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**

<b>Seq. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Natural Resources and associated problems	Land, water, food, forest, mineral and energy resources, their use, over-exploitation and conservation.	8
2	Ecosystems	Concept, structure and function of ecosystem. Producers, Consumers and decomposers, Energy flow in ecosystem. Ecological succession and pyramids, Food chains, food webs and ecological pyramids. Characteristic features of Forest, Grassland, Desert and Aquatic Ecosystems.	6
3	Environmental Pollution	Definition, Causes, Effects and control measures of Air, Water, Soil, Noise, thermal and Marine Pollution. Nuclear hazards and	8

		Solid waste management. Role of an individual in prevention of Pollution and Pollution case studies	
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 Visit to local polluted site- Urban/Rural/Industrial/Agricultural Study of Common plants, insects, birds. 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
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](mailto: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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
Major test at the end of semester	2.5 hours	30
<b>Total</b>		<b>50</b>

<b>SEMESTER III</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>Cr</b>	<b>Marks</b>
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
<b>Total</b>		<b>18</b>	<b>3</b>	<b>12</b>	<b>33</b>	<b>27</b>	<b>900</b>

**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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
1	Centrifugation	Introduction: Basic principles of sedimentation Types of centrifuges Design of centrifuges: Types of rotors Ultracentrifuge: Analytical and Preparatory	03
2	Colorimetry and Spectroscopy	Properties of electromagnetic radiations, interaction with matter. Ultraviolet spectroscopy: Origin of UV spectra, types of transition, chromophore & related terms,	02 04

		effect of conjugation, choice of solvent, instrumentation and applications Infra-red spectroscopy: Origin of infra-red spectra, modes of vibrations, instrumentation, sampling technique and applications Nuclear magnetic resonance spectroscopy: Origin of NMR, continuous wave spectrometer, chemical shifts, spin-spin coupling, Karplus equation & curve, anisotropic effect, compounds containing C <sup>13</sup> , P <sup>31</sup> & F <sup>19</sup> , applications of NMR. Mass Spectroscopy: Origin, Instrumentation, types of ions produced, interpretation and applications of mass spectra GCMS, LCMS & MSMS	04 06 06
3	Chromatography	Introduction: Chromatography theory and practice. Paper chromatography. Thin layer chromatography. Ion exchange chromatography. Affinity chromatography. Partition chromatography. Adsorption chromatography. Introduction to gas chromatography and HPLC. Permeation.	09
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	Introduction, origin of x-rays, Bragg's equation, instrumentation	05

	crystallography and Diffraction	and applications of x-ray absorption, instrumentation and applications of x-ray diffractions	
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 student 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
Major test at the end of semester	2.5 hours	60
<b>Total</b>		<b>100</b>

**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**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Cell as basic unit of living systems (Prokaryotes, Eukaryotes)	Pre-cellular evolution: artificial evolution of cells, 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
4	Structure and function of cell organelles	Cytosol, Golgi bodies, ER (smooth and rough), Cytoskeleton structures (action, microtubules etc.), Mitochondria, Chloroplasts, Lysosomes, Nucleus	14

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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting		30
<b>Total</b>		<b>50</b>

**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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 <sub>2</sub> 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
<b>Total</b>		<b>100</b>

### BOOKS RECOMMENDED:

- General Microbiology: Vol. I & 2 by Powar & Dagainawala
- 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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**TITLE OF COURSE: PLANT PHYSIOLOGY**

**L T P Hr**

**C**

**MARKS: 100**

**3 1 0 4 4**

**COURSE CODE: BT 301**

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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
	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 growth and developmeAbscissic acid Ethylene.	8

4	Phytochrome action and circadian rhythms.	The photochemical and biochemical properties of Phytochrome. Localization of Phytochrome in tissues and cells. 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 Salinity stress. Temperature (high/low)	6
12	Plant metabolism-Photosynthesis	Intracellular organization of photosynthetic system. Fundamental reactions of photosynthesis, photosynthetic pigments, role of light. Hill reaction and its significance, light reactions, cyclic and non-cyclic photo induced electron flow, energetics of photosynthesis, photorespiration, dark phase of photosynthesis, Calvin cycle, C-4 pathway, CAMP	6
		Total	48

## **METHODOLOGY**

The course would be taught through lectures, demonstrations.

## **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **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**

**MARKS: 100**

**L T P Hr C**

**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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Contact Hours</b>
1	Mendel's Principles of inheritance.	Mendel's experimental organism, the green pea. Monohybrid cross: The principle of dominance and segregation. Dihybrid cross: The principle of Independent assortment. Application of Mendel's Principles Punnett Square. Forked Line Methods, Probability Chi Square method. Mendel's Principle in Human Genetics. Pedigree. Mendel's segregation in Human families.	8

2	Extension of Mendel's Principles allelic variation and gene function.	Incomplete dominance and co-dominance. Multiple alleles. Allelic series. Variation among the effect of the mutation. Gene functions to produce polypeptides. Gene Action: Genotype and phenotype. Influence of the environment. Environmental effect on the expression of the Human Genes. Gene Interaction. Epistasis.	5
3	Chromosomal basis of inheritance	Chromosome Chromosome Number. Sex Chromosome. The chromosomal theory of heredity. Experimental evidence linking the inheritance of genes to chromosome. Chromosome as arrays of gene. Non-disjunction as proof of the chromosome theory. Chromosomal basis of Mendel's Principles of segregation and Independent assortment. Sex Linked Gene in Human Beings. Sex Chromosome and Sex Determination. Dosage Compensation of the X-linked genes.	8
4	Cytogenetics	Cytogenetical techniques. Variations in chromosome structure. Variations in chromosome number.	5
5	Non-Mendelian inheritance	Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), non-chromosomal inheritance, maternal inheritance, uniparental inheritance.	6

6	Genetic analysis of development	Model organism for genetic analysis of development. Development results from differential gene expression. Genetic study: Genetic Regulation of the development of the Drosophila body plan	5
7	Population genetics.	Theory of allelic frequencies. Natural Selection. Random Genetic Drift.	5
<b>Total Lecture</b>			42

### **METHODOLOGY**

The course would be taught through lectures, demonstrations.

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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:

**Mendelian inheritance in Pea plants****Virus – TMV (Tobacco leaves)****Bacteria – E coil (slide)****Neurospora and Yeast (slides)****Paramecium (slides)****Coenorhabditis elegans.*****Drosophila melanogaster* – Life Cycle****Mosquito (Anopheles and Culex) – Life cycle****Dissected reproductive system of Rat -****Maize, Pea, Arabidopsis – 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

**NAME OF THE COURSE: MAMMALIAN PHYSIOLOGY**

**COURSE CODE: BS 305**

**L T P Hr C**

**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.

**COURSE DESCRIPTION**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 <sub>2</sub> and CO <sub>2</sub> in the blood and body fluids. Chloride & reverse chloride shift	4
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	4

		concentration and auto regulation.	
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. Insulin, glucagons and related disorders. Parathyroid hormone, calcitonin and calciterol. Sex hormone: progesterone, estrogen and testosterone.	4
7.	Reproductive system- Physiology	Male and female systems, Histology of male and female reproductive organs. Maintenance of female reproductive system, Female Reproductive Cycle, 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 and space physiology:	Effect of low oxygen pressure, Effect of high altitude on physiology, Artificial climate in the sealed spacecraft, Weightlessness in space.	4
10.	Physiology of deep sea diving and other hyper baric candidates.	Effect of high pressure and decompression on diver, Hyper baric oxygen therapy.	4
Total number of lectures			48

## **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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **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



<b>SEMESTER IV</b>							
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Hr</b>	<b>C r</b>	<b>Marks</b>
BT 401	Molecular Biology-I	3	0	4	7	5	200
BT 402	Metabolism	3	1	0	4	4	100
BT 408	Animal Tissue Cultures & Stem Cells	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
<b>Total</b>		<b>18</b>	<b>4</b>	<b>14</b>	<b>33</b>	<b>26</b>	<b>950</b>

**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**

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

	Genome:	ribose sugar, Phosphoric acid, Nucleosides and Nucleotides) Structure of RNA What is Chromosome? Structure of chromosome, what is chromatin? Chromosome and chromatin diversity Chromosomal duplication and segregation, Nucleosome structure Higher order chromatin structure, Regulation of chromatin structure Mitochondrial genome..	
3	Replication of DNA in Prokaryotes and Eukaryotes:	Chemistry of DNA synthesis, Mechanism of DNA polymerase, replication fork (Okazaki fragments)  Termination and control of DNA replication.	7
4	Mutation and DNA repair	Types of mutations. Replication errors and their repairs. 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, genetic consequences of mechanism of recombination. Site specific recombination and transposition of DNA: conservative site specific recombination, biological roles of sites recombination, transposable elements, and their regulations, V9DJ recombinants Gene conversion.	10

6	Transcription & Translation in	Transcription in Prokaryotes (role of proteins and factors etc.) Transcription in Eukaryotes (role of proteins and factors etc.) RNA Splicing and RNA editing	6
7	Control of Gene Expression:	Prokaryotes, Lac Operon and Catabolite repression Eukaryotes, Transcription Factors Yeast, Protozoan Gene organization & expression in mitochondria and chloroplast Post translation regulation of gene expression Development and environmental regulation of gene expression	7
8	Oncogenes and Cancer:	Tumor cells, tumor suppressors genes, 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
<b>Total</b>		<b>100</b>

### 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<sup>th</sup> 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 Energy balance sheet, regulation of glycolysis by enzymes and hormones, Anaerobic pathway of glucose metabolism.	3
3	Gluconeogenesis & Glycogen Metabolism	Bypass reactions Regulation of gluconeogenesis by enzymes and hormones.	6

		Glycogenolysis and glycogenesis	
4	Citric acid cycle(TCA)	Aerobic pathway of glucose metabolism- detailed study of all the reactions 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 $\beta$ oxidation of monounsaturated and polyunsaturated fatty acids, Energetics of $\beta$ oxidation, ketone bodies.	2
7	Oxidative phosphorylation	Oxidative phosphorylation, structure of ATPase enzyme, chemiosmotic hypothesis. 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-diacylglycerol, plasmalogens, sphingolipid, glycerophospholipid, PDGF. Cholesterol from acetyl CoA, fates of cholesterol, regulation of cholesterol biosynthesis, steroid hormones from cholesterol, bile salts	9
	Integration of Carbohydrates, lipids and fats metabolism	Integration of Carbohydrates, lipids and fats metabolism	2
	Biosynthesis of amino acids and	Glutamate, glutamine, proline and arginine from $\alpha$ - ketoglutarate,	6

	its regulation	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	
	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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

#### **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, Addison Wesley Publication [1988]
- Biochemistry by Corn and Stump



**TITLE OF THE COURSE: ANIMAL TISSUE CULTURE AND STEM CELLS**

**COURSE CODE : BT 408**

**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**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Introduction:	<ul style="list-style-type: none"><li>• History,</li><li>• Cell culture techniques,</li><li>• Equipment and sterilization methodology.</li></ul>	4
2	Introduction to animal cell cultures:	<ul style="list-style-type: none"><li>• Nutritional and physiological: Growth factors and growth parameters</li><li>• General metabolism and Growth Kinetics</li></ul>	6
3	Primary cell cultures	<ul style="list-style-type: none"><li>• Establishment and maintenance of primary cell cultures of adherent and non-adherent cell lines with examples.</li></ul>	4

4	Secondary cell cultures	<ul style="list-style-type: none"> <li>Establishment and maintenance of secondary and continuous cell cultures</li> </ul>	2
5	Characterization of cell lines	<ul style="list-style-type: none"> <li>Karyotyping, biochemical and genetic characterization of cell lines, Identification of cells, adventitious agents</li> </ul>	2
6	Application of cell cultures	<ul style="list-style-type: none"> <li>Vaccine production ,e.g. Measles, Rabies</li> <li>Use of Hybridoma for production of monoclonal antibodies.</li> <li>Therapeutic biological products, cytokines etc</li> </ul>	2
7	Bioreactors in animal cells	<ul style="list-style-type: none"> <li>Bioreactors for large-scale culture of animal cells</li> </ul>	2
8	Tissue engineering	<ul style="list-style-type: none"> <li>Principle and theory of tissue engineering</li> <li>Applications of tissue engineering</li> </ul>	3
9	Cryopreservation and tissue culture applications	<ul style="list-style-type: none"> <li>Cryopreservation</li> <li>Tissue culture applications</li> </ul>	2
10	Stem Cells Introduction	<p>What Are stem cell?  Where Do stem cell Come from?  Why Are stem cells here?  Where Are stem cells going?</p>	2
11	Stem Cells from Early Mammalian Embryos Adult stem cells ,Mesenchymal stem cells	<p>Introduction to ES cells, EC cells, EG cells and TS cells.  Their origin and characteristics.  Adult stem cells ,Mesenchymal stem cells</p>	6
12	Embryonic Stem cells	<p>Isolation of ES cells  Salient features of ES cells  Application of ES cells.</p>	4

13	Stem Cells to Functional Tissue Architecture	What Are the Signals? How they are processed?	4
14	Stem Cells and Cloning	Therapeutic and reproductive cloning Nuclear Transfer method Application of NT ES cells. Safety of NT ES cells.	3
15	Future for stem cell research Ethics	Medical treatment Organ regeneration Ethical consideration ,Regulating issues	2
		Total	48Hrs

### **METHODOLOGY**

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

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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. Humana 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 by Stanbury P.F., Wittakar A. & Hall S.J. Pergamon Press. Oxford. 1995.
- Stem cell handbook, by STEWART SELL, Humana Press. Inc. 2004.

## **PRACTICAL OF ANIMAL TISSUE CULTURE AND STEM CELLS**

**(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.
10. Preparation of stem cell culture medium
11. Cryopreservation of stem cells.

### **EVALUATION SCHEME PRACTICAL TRAINING**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

**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**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 area Equipments and instruments required..	4

3	Aseptic techniques	Washing of glassware, Media sterilization 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 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 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 What is protoplast culture How protoplast fusion is done Stages of protoplast culture, Requirement and application	7
10	Micro propagation	Concept, requirements, stages, explants, mention of somaclonal variation Different pathways of micropropagation: Axillary bud proliferation Somatic embryogenesis Organogenesis. Meristem culture	6

11	Secondary metabolites production and biotransformations.	Introduction, principal, optimization of yield. Commercial aspects, applications and limitations.	3
12	Plant tissue culture production of:	Agricultural crops Forest tree Ornamental plants Medicinal plants. Endangered plant species.	3
13	Applications of Plant Tissue Culture:	Somatic hybridization Somaclonal variation Germplasm preservation Genetic transformations Production of artificial seeds. 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
<b>Total</b>		<b>100</b>

### 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>



**TITLE OF THE COURSE: IMMUNOLOGY****COURSE CODE: BT 405****MARKS: 150****L T P Hr C****3 0 2 5 4****OBJECTIVE OF THE COURSE:**

The objective of the course is to familiarize the students with the immune system and its 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 of immunoglobulin gene. They should know some basic assays.

**COURSE DESCRIPTION**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Introduction to immunology	<ul style="list-style-type: none"><li>• Overview of Immune system: History and scope of Immunology, Types of immunity: innate, acquired, Comparative immunity. Immune dysfunction and its consequences.</li><li>• 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, spleen mucosal associated lymphoid tissues</li></ul>	6

2	Generation of B-cell and T-cell response:	<ul style="list-style-type: none"> <li>• Antigens: Immunogenicity vs. antigenicity</li> <li>• Epitopes (properties of B-cell and T-cell epitopes)</li> </ul>	4
3	Immunoglobulins Structure and Function:	<ul style="list-style-type: none"> <li>• Basic and fine structure of immunoglobulin: light chains, heavy chains and sequences</li> <li>• Antigen determinants on Immunoglobulin: Isotopic, allotypic, Idiotypic</li> <li>• Immunoglobulin super family</li> </ul>	6
4	Immunoglobulin Classes and Biological Activity:	<ul style="list-style-type: none"> <li>• Immunoglobulin mediated effectors functions optimization</li> <li>• Activation of complement</li> <li>• Antibody dependent cell mediated cytotoxicity.</li> <li>• Clinical focus: Passive antibody therapy (IgG, IgM, IgA, IgE and IgD), hypersensitivity and immunological disorder</li> </ul>	6
5	Organization and Expression of Immunoglobulin Genes:	<ul style="list-style-type: none"> <li>• Genetic model compatible with Ig structure</li> <li>• Multigene organization of Ig genes</li> <li>• Variable region gene rearrangements</li> <li>• Mechanism of variable region DNS rearrangements</li> <li>• Generations of antibody diversity</li> <li>• Class switching among constant regions genes</li> <li>• Expression of Ig genes</li> <li>• Regulation of Ig-gene transcription</li> <li>• Antibody and genes and antibody engineering</li> <li>• Clinical focus</li> </ul>	8

6	Antigen Antibody Interactions:	<ul style="list-style-type: none"> <li>• Strength of antigen and antibody interactions: Antibody affinity, antibody avidity</li> <li>• Cross reactivity</li> <li>• Precipitation reactions, agglutination reactions (immunodiffusion and immunoelectrophoretic technique)</li> <li>• Radioimmunoassay</li> <li>• Enzyme linked Immunosorbant./Assay(ELISA)</li> <li>• Western Blotting</li> <li>• Immuno precipitation</li> <li>• Immunofluorescence</li> <li>• Flow cytometry and Fluorescence</li> </ul>	6
7	MHC-Major Histo-compatibility complexes	<ul style="list-style-type: none"> <li>• MHC molecules and genes</li> </ul>	4
8	Immune System in Health and Disease:	<ul style="list-style-type: none"> <li>• Immune response to infectious disease (viral, bacterial and protozoan)</li> <li>• Vaccines (whole organism, purified macromolecules, recombinant vaccine, synthetic polypeptide etc.</li> <li>• AIDS, and other acquired or secondary immuno deficiency orders</li> <li>• Autoimmunity</li> <li>• Transplantation immunology: graft rejections, graft vs host response</li> <li>• Cancer and immune system</li> </ul>	8

## **METHODOLOGY**

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

## **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **BOOKS RECOMMENDED:**

1. Immunology 5<sup>th</sup> edition by Janis Kuby ( W.H Freeman and company)\*
2. Essentials of Immunology by Ivan M. Roitt 5<sup>th</sup> Edition  
Blackwell Scientific Publ.
3. Cellular and Molecular Immunology, 3<sup>rd</sup> 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

**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**

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

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 alignment	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 $\phi$ & $\psi$ Angles, Ramchandran Plot Tertiary & Quaternary Structure Hydrophobicity, Disulphide bonds Active Sites	04
11	Introduction to	Homology, Analogy, Orthology Paralogy, Xenology	02
<b>Total Lectures</b>			<b>45</b>

## **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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **BOOKS RECOMMENDED**

- Introduction to Bioinformatics Kotheekar 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**  
**Week)**

**(4 Hrs. Per**  
**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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

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

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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
<b>Total number of Lectures</b>			<b>48</b>

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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<sup>th</sup> 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**

<b>Sr. No.</b>	<b>Laboratory exercise</b>	<b>Hrs</b>
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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
1	Introduction	Landmarks in Molecular biology and biotechnology, Advantages of using microorganisms, What is genetic engineering and recombinant DNA technology, Control of gene expression and gene complexity in prokaryotes and eukaryotes., Genetic engineering in <i>Ecoli</i> 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. Cloning vectors-plasmids, bacteriophage vectors,cosmids,phagemids,vectors for	6



		plant and animal cells, shuttle vectors, YAC vectors, expression vectors etc..	
3	Gene cloning	Isolation and purification of DNA (genomic, plasmid) and RNA,, Isolation of gene of interest- restriction digestion, electrophoresis, blotting,, Cutting and joining of DNA,, Methods of gene transfer in prokaryotic and eukaryotic cells, Recombinant selection and screening methods- genetic, immunochemical, South-western analysis, nucleic acid hybridization, HART, HRT, 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 Antisense therapy, Transgenics.	02
8	Genetic disorders- Diagnosis and	Prenatal diagnosis, Single nucleotide polymorphisms, DNA microarrays, Future strategies.	02

	screening		
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 student 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
<b>Total</b>		<b>100</b>

### 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 enzymology. 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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
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. Isoenzymes and multiple forms	2

		of enzymes.	
2	Enzyme Kinetics & regulation of Enzyme action	Michaelis Menten equation, Significance of Km & Vmax. Enzyme inhibition- types and their kinetics. Enzyme activity, international units, specific activity, turnover number. Structure-Function Relations: chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference to carboxypeptidases. Ribozymes.	10  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, Medicine, Diagnostics, Production of new compounds, As research tools (ELISA method) Leather industry, textile industry.	8
5	Enzyme Technology	Recent advances in enzyme technology, Use of unnatural'	8

		substrates, Enzyme engineering, Artificial enzymes, Coenzyme-regenerating systems.	
<b>Total Lectures</b>			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 student 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

#### **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 Publication. 2008.
- Biochemistry by Stryer (4<sup>th</sup> 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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:**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
<b>1</b>	<b>Toxicology Introduction</b>	Definition and derivation of toxicology Sister sciences, endocrinology and pharmacology Definition of toxins and toxicants Key features of toxicology and study of toxicants Modes of exposure, elimination, bioavailability, partition	<b>02</b>
<b>2</b>	<b>Dose</b>	Toxicant targets	<b>04</b>

	<b>Response</b>	<p>Physiologic dose-response</p> <p>The role of intercellular chemical communication: hormone, receptor, transducer, effectors</p> <p>Agonist, antagonist</p> <p>Interconnections of transduction mechanisms</p>	
<b>3</b>	<b>Chemical Kinetics</b>	<p>Principles and practice of transition state mimicry</p> <p>Illustrative examples, collected substrate analog inhibitors ,and design strategies</p>	<b>06</b>
<b>4</b>	<b>Cell death</b>	<p>Necrosis, Apoptosis;</p> <p>Neural and immune function overview</p>	<b>04</b>
<b>5</b>	<b>Metabolism</b>	<p>Biochemistry of toxicant metabolism</p> <p>Enter hepatic circulation</p> <p>Toxic dynamics and toxic kinetics</p>	<b>05</b>
<b>6</b>	<b>Reproduction</b>	<p>Gamete production in mammals</p> <p>Gestation in mammals</p>	<b>06</b>
<b>7</b>	<b>Mammalian toxicity</b>	<p>Mammalian toxicity testing: in vivo, in vitro,</p> <p>Multigenerational</p> <p>Molecular methods, high throughput testing</p>	<b>05</b>
<b>8</b>	<b>Dosage</b>	<p>Stress and dose interactions</p> <p>Diet as modulator or mode of exposure</p> <p>Developmental status/age and toxicity</p> <p>Predispositions to toxic risk</p> <p>Moderators of toxic risk</p> <p>Carcinogenesis</p>	<b>10</b>
<b>9</b>	<b>Clinical Developments</b>	<p>Screening systems and their construction strategies</p> <p>Alternative strategies in lead</p>	<b>06</b>



		identification, lead optimization, pre-clinical development: Clinical trials, patenting and clearance for application	
<b>Total number of Lectures</b>			<b>48</b>

**METHODOLOGY :**

The course would be taught through lectures, demonstrations.

**EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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**

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

		trouble shooting -Bioreactor types for products of microbial, plant and animal origin -Role of computers in fermentation processes	
3	Sterilization	-Sterilization of Fermenter (batch and continuous processes) -feed sterilization -sterilization of liquid wastes -Filter sterilization	4
4	Isolation of microbes and Strain improvement	-Isolation and preservation of industrially important microbes -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 - identification of variables important for fermentation -Medium optimization using conventional and statistical designs - Inoculum development for bacterial, fungal and yeast strains -Aseptic inoculation in fermenter	7
6	Microbial Growth Kinetics	Kinetics of growth -in batch culture -in continuous culture -fed-batch culture	6
7	Downstream processing	-Cell separation techniques -Concentration of metabolites -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
<b>Total number of lectures</b>			<b>48</b>

### **METHODOLOGY**

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

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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**

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

3	Molecular methods and Production	Methods And application of molecular cloning in foods Developmental technique for new plant varieties	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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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**

<b>Sr. No.</b>	<b>Topics</b>	<b>No. of Lectures</b>
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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

### **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**

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

3	Air pollution and its control	Active trace gases in air Aerosols in air Control of air pollution through biotechnology	03
4	Microbiology of waste water treatment	Aerobic System 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. Anaerobic System Anaerobic biological treatment - contact digesters, packed column reactors, UASB.	06
5	Microbiology of degradation of xenobiotics	Xenobiotics in environment Decay behavior of xenobiotics	04
6	Bioremediation	Bioremediation I Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation Bioremediation- II 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 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 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 biotechnological applications to hazardous waste management - cyanide detoxification - detoxification of oxalate, urea etc. - toxic organics - phenols.	6
10	Advances in Environmental Biotechnology	GIS in Environmental Management Computer based Environmental modeling Design of ETPs	06
Total number of Lectures			48

## **METHODOLOGY**

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

## **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **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 Karrelly 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
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
<b>Total</b>		<b>18</b>	<b>3</b>	<b>8</b>	<b>29</b>	<b>25</b>

### Elective II:

**BI 504: Operating Systems**

**BI 603: Perl & Bioperl**

**BI 606: Computer Networking**



**TITLE OF THE COURSE: VIROLOGY**

**L T P Hr C**

**COURSE CODE: BT 601**

**3 1 0 4 4**

**MARKS: 100**

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	The Viruses	Discovery, virus structure, classification, viral replication cycle, detection and enumeration of viruses, virus cultivation in lab, virioids, 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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 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 DESCRIPTION**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Management Principles:	Role of managers and leaders in biotechnology companies Innovative problem solving strategies Diverse and global work force Developing partnerships with other businesses	20

		Customers and competitors Utilization of technology Current challenges in organization Leadership skills, communication, conflict resolution, goal integration	
2	Creating Biotechnology Enterprise:	Market assessment of innovative technology Patents and licensing Corporate law Preparation of a business plan Raising money from venture capitalists Government grants Strategic alliances Sales and marketing Real estate Human resources Regulatory affairs 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 on 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
<b>Total</b>		<b>100</b>

### BOOKS RECOMMENDED:

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

**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 confident 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 Principles General lab requirements Definitions and Biosafety levels: 1,2,3,4 Summary Biological safety cabinets: centrifuges, Shipment of biological specimens, Biological waste management, Decontamination, Biosafety manuals, Medical surveillance, Emergency response	18

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

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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

**COURSE NAME: GENOMICS, TRANSCRIPTOMICS AND PROTEOMICS**

**COURSE CODE: BT-602**

**L T P Hr C**

**MARKS: 150**

**3 1 2 6 5**

**OBJECTIVE:**

Objective of the course is to familiarize students with the principles and techniques of high throughput genome analysis and gene expression. Such a study finds application in all the fields of genome and gene expression analysis in prokaryotes and eukaryotes.

**LEARNING OUTCOME:**

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

**PREREQUISITE:**

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

**COURSE DESCRIPTION:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Detail</b>	<b>Hrs.</b>
1.	GENOMICS	Introduction to genomics and its scope. Comparative, functional, personalized and pharmacogenomics.  Concept of gene ontology and ontology database.  High throughput DNA sequencing technology, advances in next generation sequencing technology.  Genome Centers and their organization, Genome databases.  Bioinformatics tools for the analysis of global gene expression, NCBI, TIGR, BLAST	3  1 4  2  3 2
2.	TRANSCRIPTOMICS	Transcription and post-transcriptional modifications.	2  2



		Concepts in transcriptomics and its scope.	2
		Global expression profiling and Microarray gene expression analysis.	2
		Expressed sequence tags (ESTs), Sampling of ESTs from cDNA libraries. Bioinformatic analysis of transcriptome by ESTs database.	2 1
		Serial Analysis of gene expression (SAGE). Massively parallel signature sequencing (MPSS ) Bioinformatic analysis of promoter prediction, splice site termination site.	2
3.	PROTEOMICS	Concepts in proteomics and its scope. 2D gel electrophoresis and PD quest analysis of differentially expressed protein spots Mass Spectrometry Matrix Assisted Laser Desorption Ionization /Time of flight (MALDI/ TOF) SELDI Electrospray ionization (ESI) Multidimensional liquid chromatography Reverse phase HPLC Bioinformatic analysis of Proteome SWISS PROT, PIR,PDB X ray crystallography Nuclear Magnetic Resonance ( NMR) General protein array, Antigen array. Phosphoproteomics siRNA mediated gene silencing technique.	1 2 1 1 1 2 2 1 1 1 1 1 1 1 1
4.	Applications	Application of genomics, Transcriptomics and proteomics in agriculture, medicine and industry.	3
		Total	48

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **REFERENCES BOOKS:**

1. Discovering Genomics, Proteomics, and Bioinformatics by A. Malcolm Campbell and Laurie J. Heyer, Benjamin Cummings publications, II edition, 2003
2. Transcriptomics by Virendra Gomase and Somnath Tagore, VDM Verlag, 2009
4. Genome Transcriptome and Proteome Analysis by Alain Bernot, John Wiley and Sons Ltd. 2004
5. The Dictionary Of Genomics, Transcriptomics And Proteomics by Guenter Kahl Atlantic publisher, 2009, Vols I, II and III
6. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbour Laboratory Press ( CSHLP), II edition 2004

**PRACTICALS IN GENOMICS, TRANSCRIPTOMICS AND  
PROTEOMICS (4 Hrs. Per Week) 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:**

<b>Sr. No.</b>	<b>Name of practical</b>	<b>Hrs</b>
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.	<i>in-vitro</i> 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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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: 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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of lectures</b>
1	Introduction to Biochemical Engineering	-Fundamentals of biochemical engineering -Biotechnology and Bioprocess engineering	2

2	Stoichiometry & Energetic	-Principles of thermodynamics -Stoichiometry for metabolic pathways: Carbon metabolism, biosynthesis of molecules, Stoichiometry of cell growth and product synthesis, theoretical predictions of yield coefficients with examples	6
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 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, $K_L a$ and oxygen transfer rate, rheology and its relation to mass transfer, non-Newtonian fluids, factors affecting $K_L a$ , 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,	Consideration of parameters for scale up,	6

	process economics and applications	process economics: one example from laboratory to market and economic considerations, mathematical modeling of one system like anaerobic digester and simulation studies	
8	Case Studies	Case studies (Product or technology based) <ul style="list-style-type: none"> <li>- Microbial system</li> <li>- Animal system</li> <li>- Recent developments</li> </ul>	5
	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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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, 2<sup>nd</sup> 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 ( $\mu$ ), Saturation constant (KS) and growth yield ( $Y_{x/S}$ ), Sp. product formation rate ( $Q_1$ ) 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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>



**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 Platform for the future Drawbacks of Current Trend Net Framework – BCL & CLR   Key design goals CLR, CTS, MSIL & other tools. Multiple Language Interaction & support   Moving from Project to Assemblies... Security in .NET – CAS Advantages/Disadvantages Features of .Net Assemblies in Detail GAC, Strong Names	4
2	Visual C#.Net Language	Advantages/Disadvantages Why C#/ Why Not C#	5

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

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

		How to use classes as part of project	
6	Object Oriented Concepts (Advanced)	Accessibility levels, specifiers Constructors Method overloading Class (static) variables & methods Object destruction 'ref' and 'out' parameters Constant values Enumerations Inheritance and Polymorphism The root of all classes Creating derived classes Method overriding and hiding Polymorphism and virtual functions Casting objects Abstract classes Sealed classes Static classes	6
7	Error Handling	Unstructured error handling support Structured error handling Error categories Debugging the application Debug and Trace classes Code Optimization Testing and strategies	4
8	Ado.Net	Ado.Net Components Data Sources And .Net Data Providers Accessing Data In The Connected Environment Accessing Data In Disconnected Environment	7

		Sorting, Searching And Filtering	
8	ASP.Net	Introduction to web technologies Web Forms Architecture ASP.Net and HTTP Web application developing using Visual Studio State Management and Web Applications ASP.Net Server-side controls Caching in ASP.Net ASP.Net application configuration Debugging, Diagnostics of application Connectivity with Database using ADO.Net/Entity Framework Data Access Controls Personalization and Security	8
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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessme		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

**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 Network Hardware Network Software Reference Models Network Examples Network standardization	06
2	The Physical Layer	The theoretical basis for data communication Guided transmission media Wireless transmission Communication satellites	06



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

8	Network Security	Cryptography Symmetric key algorithms Public key algorithms Digital signatures Management of public keys Communication security Authentication protocols E-mail security Web security 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 student 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 solved before the semester ending.

### **Evaluation Scheme (Theory)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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**

<b>Sr. No.</b>	<b>Topics</b>	<b>Detail syllabus</b>	<b>No. of Lectures</b>
1	Overview	Operating systems, Functionalities and characteristics of OS. Hardware concepts related to OS, CPU states, I/O channels, memory hierarchy, microprogramming, Structure of Disk, Disk Storage Allocation Schemes for File Allocation Table The concept of Process, operations on processes, process states, concurrent processes, process control block, process context	3

2	File Systems Responsibilities of OS	File operations, attributes, extensions, types Access Methods Directory Organization Single Level Two Level Tree Structured Acyclic Graph Directory General Graph Directory Protection Consistency Semantics File System Implementation Management of Free Space Disk Scheduling Algorithms	3
3	History Using Windows OS	OS Features, capabilities, limitations 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 Job and processor scheduling, scheduling algorithms, process hierarchies Problems of concurrent processes, critical sections, mutual exclusion synchronization, deadlock Mutual exclusion, process co-operation, producer and consumer processes	4
5	Semaphores	definition, init, wait, signal operations Use of semaphores to implement mutex, process synchronization implementation of semaphores	3
6		Critical regions, Conditional Critical Regions, Monitors, Ada Tasks.  Interprocess Communication (IPC), Message Passing, Direct and Indirect.  16. Deadlock: prevention, detection, avoidance, banker's algorithm	4

7	Memory management	Memory organization and management, storage allocation Virtual memory concepts, paging and segmentation, address mapping Virtual storage management, page replacement strategies	4
8	File organization	blocking and buffering, file descriptor, directory structure File and Directory structures, blocks and fragments, directory tree, inodes, file descriptors, UNIX file structure	4
9	Overview of the Linux OS	History Architecture Features and capabilities Kernel, shell & applications File System / Directory Structure Multitasking and Multi-user system Operating modes ( RC scripts, Init levels)	4
10	Important concepts in a Linux environment	Login Login scripts & profiles X window system, the GUI under Linux Different window manager Linux Installation Linux Shell Programming Vi Text Editor, Shell Variables Examples Piping and redirection copy, rename, delete and move directory listing, file handling and IO redirection	5
11	Users and Groups	Concept of users and groups Owner creator Primary and secondary group types of file and directory permission	3
12	Basic commands	Miscellaneous other commands cat, cal, date, passwd, less, grep, wc, bc	4

	and using GUI	uname, etc KDE Editors (Kwrite, Kedit) Office Applications (word processors, spreadsheets) Internet related applications (browsers, mail , clients) Multimedia applications	
13	Command Line Interface	Additional text manipulation commands. e.g. cut, grep, split, paste, basename and various other gnu utils etc. Working with bash Login scripts and profiles Shell scripting Introduction to regular expressions Process management	4
14	Trouble Shooting	Tips and Tricks Getting help 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 student 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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, Operating 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>



## 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
<b>Total</b>		<b>100</b>

### BOOKS RECOMMENDED

- Solutions & Examples for Perl Programmers by Nathan Torkington and Tom Chistiansen.
- Network Programming with Perl(1<sup>st</sup> 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

## Semester VII

Course Code	Course Name	L	T	P	Hr	Cr
BT 701	Biomembrane & Molecular Cell Signaling	3	1	0	4	4
BT 702	Nanobiotechnology and Biosensors	3	0	4	7	5
HU 701	Quality Control Management in Biotechnology	3	1	0	4	4
BT 703	Advances in Biotechnology	3	0	0	3	3
BT 704	Seminars in Biotechnology	3	1	0	4	4
BT707/ 708/ 709/710	Elective III	3	0	4	7	5
<b>Total</b>		<b>18</b>	<b>3</b>	<b>8</b>	<b>29</b>	<b>25</b>

### **Elective III:**

**BT 707 : Metabolic Engineering**

**BT 708 : Marine Biotechnology**

**BT 709 : Agricultural Biotechnology**

**BT 710 : Biopharmaceuticals**

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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) Receptor characterizations Receptor functions Extra cellular receptors 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 signal transduction	Coupling of activation receptors to intracellular signal transducing machinery; protein kinase(s) cascade	06

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
<b>Total number of Lectures</b>			<b>48</b>

**METHODOLOGY:**

The course would be taught through lectures and demonstrations.

**EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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

**TITLE OF THE COURSE: NANOBIO TECHNOLOGY & BIOSENSORS**

**COURSE CODE: BT 702**

**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 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**

<b>Sr. No</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
1	Introduction to Nanobiotechnology	Nanotechnology, Broad perspective, and Today's World, Importance of Nanoscale Science and Technology	3
2	History of Nanobiotechnology	Growth of Nanotechnology and development of Nanobiotechnology	3
3	Nanomaterials and nanoparticles	Pure metals, Metal oxides, Techniques to synthesize nanoparticles, Characterization of nanoparticles, Applications, Toxic effects of nanomaterials Carbon nanotubes- Chemistry of	10



		carbon nanotubes, types of carbon nanotubes, dendrimers, quantum dots, nanosomes	
4	Nanotechnology and Life Sciences	Nanotechnology in medicine -Drug delivery -Drug encapsulation -Tissue repair and implantation -Bioresorbable materials -artificial organs -other applications	10
5	Biosensors: General concepts	-Introduction to biosensors -History of discovery of biosensors -Components of a typical biosensor	02
6	Construction and designing of biosensors	- Properties of biosensors -Types of biosensors (Calorimetric, Potentiometric, amperometric, optical, Piezo-electric, Immuno based sensors) -Representative design of each type of biosensor -Biomarkers and their role in development of medical biosensors	08
7	Applications of biosensors	-Associated electronics with each category of biosensor - Applications related to healthcare, bio-defense, food and water safety, agriculture and environment - Multidisciplinary interactions for biosensor development	08
8	Case studies	-Success and failure of Nanodevices and biosensors with suitable examples -Market status of Nanodevices and nanomedicine	04
		Total Lectures	48

## **METHODOLOGY**

The course would be taught through lectures and tutorials.

## **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

## **BOOKS RECOMMENDED:**

- Bionanotechnology by David S. Goodsell 2004. John Wiley & Sons.
- Biosensors: Fundamentals and applications, Oxford, U.K: Oxford University Press by Turner, A.P.F., Karube, I. & Wilson, GS. Oxford university Press. 1987
- Weiss, Thomas Fischer. Cellular biophysics. Cambridge, Mass., MIT Press.1996

**PRACTICALS IN NANOBIO TECHNOLOGY & BIOSENSORS**  
**(4 Hrs. Per Week) MARKS: 100**

**LIST OF PRACTICALS**

**EVALUATION SCHEME PRACTICAL TRAINING**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	15
Continuous Assessment		05
End semester Exam Viva & Spotting	2.5 hours	30
<b>Total</b>		<b>50</b>

**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:**

<b>Sr. No.</b>	<b>Topic</b>	<b>Description</b>	<b>Hrs</b>
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 Pharmacopeias	1

		US Pharmacopeias, Extra Pharmacopeias	
5	Good manufacturing processes	Introduction GMP and CGMP, GXP and GCP	3
6	Key requirement of C GMP	C GMP for API manufacturing Quality management, Personnel Building and facilities, Documentation Material management, Production and Inprocess control Packaging Storage and distribution Laboratory control Validation, Change control Rejection and reuse of material, Complaints and recall Contract manufacturers, Agents, Brokers, Traders, Distributors, Repacker and retailer	15
7	Good Laboratory Practices	History, Present Status Indian scenario	4
8	ICH	ICH guidelines History and Introduction, Necessity of ICH International scenario and Indian scenario	4
9	SOP	Standard operating procedures	2
10	MVP	Master Validation Plan in labs and industry	2
11	Accreditation & Registration with various Regulatory Authorities	National Accreditation Board for Testing & Calibration(NABL) 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 on the subject. The students will be evaluated based on class test, lecture attendance, class participation, Write-up and power point presentation.

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **BOOKS RECOMMENDED:**

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

**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:**

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

3	Enzymes, Compounds and Reaction databases	LIGAND-Biochemical Compound and Reaction ENZYME-Enzymes BRENDA- Comprehensive Enzyme Information System Full Genome Annotation through knowledge of Metabolic Pathways Organism Specific Metabolic Pathways, Comparison of Metabolic Pathways, Engineering of Metabolic pathways, Representation of Metabolic Pathways Generation and Dynamic Representation of Metabolic Pathways Knowledge 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

#### **BOOKS RECOMMENDED:**

1. Metabolic engineering edited by Sang Yup Lee and Eleftherios T. Papoutsakis
2. Metabolic engineering - Principles and Methodologies 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**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

**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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**Elective III****TITLE OF THE COURSE: AGRICULTURAL BIOTECHNOLOGY****COURSE CODE : BT 709****MARKS : 200****L T P Hr C****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 <ul style="list-style-type: none"><li>• Micro propagation</li><li>• In vitro production of pathogen and contaminant free plants</li></ul>	4 3
3	Biotechnology- Methods of Crop Improvement <ul style="list-style-type: none"><li>• Genetic Engineering of Crop Plants</li></ul>	3 3
4	Transgenic Plants	4
	Molecular Markers	3

	QTL Mapping	3
5	Metabolite Production <ul style="list-style-type: none"> <li>• Production of Secondary Metabolites</li> <li>• Production of foreign compounds in transgenic plants</li> </ul>	5
6	Biofertilizers and Bioremediation <ul style="list-style-type: none"> <li>• Microbial Biopesticides , Biofungicides, Herbicides and Agricultural antibiotics</li> </ul>	7
7	Biotechnology in Agriculture <ul style="list-style-type: none"> <li>• Ethical Aspects and Public Acceptance</li> </ul>	3
8	Animal farming, Animal farming with organic concept, Animal Breeding & Genetically modified animal products.	5
	<b>TOTAL</b>	<b>45</b>

### **METHODOLOGY**

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

### **EVALUATION SCHEME (THEORY)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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, CO<sub>2</sub>, inside the green house. Calculation of environment indices inside green house. Fertigation, Post harvest.

### ***EVALUATION SCHEME PRACTICAL TRAINING***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

**Elective III****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 How are Biopharmaceuticals different from Pharmaceutical products	4
2	The drug manufacturing 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 therapeutic 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
4	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 adjuvants	Polyclonal antibodies, Monoclonal antibodies and their production by hybridoma technology, applications of Monoclonal antibodies 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)**

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
I Internal	45 minutes	15
II Internal	45 minutes	15
Teachers assessment		10
End Semester Exam	2 hours 30 minutes	60
<b>Total</b>		<b>100</b>

### **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***

<b>Examination</b>	<b>Duration</b>	<b>Marks</b>
Minor test 1	1 hour	30
Continuous Assessment		10
End semester Exam Viva & Spotting	2.5 hours	60
<b>Total</b>		<b>100</b>

### SEMESTER VIII

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