Dr. D. Y. PATIL VIDYAPEETH, PUNE
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DR. D. Y. PATIL BIOTECHNOLOGY & BIOINFORMATICS INSTITUTE

TATHAWADE, PUNE

SYLLABUS FOR

B. TECH. MEDICAL BIOTECHNOLOGY

2023-2024

B. Tech Medical Biotechnology Programme
Program Outcomes (PO)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO-1	Integrating principles of biology, engineering, and technology to develop biopharmaceuticals, biosimilars, neutraceuticals, biomedical devices, artificial organs and related biomedical solutions
PSO-2	Contribute to advancements in industry practices, consultancy services, and research initiatives within the healthcare sector
PSO-3	Adhere to ethical standards and regulatory compliance for biomedical research and products.

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TATHAWADE, PUNE

COURSE STRUCTURE FOR B. TECH. MEDICAL BIOTECHNOLOGY

SEMESTER I							
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**	**Revised Marks T, P**
BS101	Physics	3	0	2	5	4	100, 50
BT101	Electronics & Instrumentation Engineering	2	0	2	4	3	50, 50
BI101	Python for Biologists	2	0	4	6	4	50, 100
HU101	Communication Skills	1	1	0	2	2	50
BS103	Maths I – Mathematics	2	0	0	2	2	50
BTAEC101	Aptitude Building-I	0	0	2	2	1	50
Total		**13**	**1**	**12**	**26**	**20**	**700**
SEMESTER II							
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**	**Revised Marks T, P**
MB201	Medical Biochemistry	3	0	4	7	5	100, 100
BT202	Cell Biology	3	0	2	5	4	100, 50
BS201	Maths II -Statistics	2	0	2	4	3	50, 50
BT203	Engineering Mechanics	2	0	2	4	3	50, 50
BS202	Environmental Sciences	2	0	2	4	3	50, 50
BT204	Engineering Graphics	1	0	2	3	2	50, 50
HU201	Disaster Management*	0	1	0	1	0	Audit
BTIKS201	History of Indian Science	1	0	0	1	1	50
BTAEC201	Aptitude Building-II	0	0	2	2	1	50
Total		**14**	**1**	**16**	**31**	**22**	**850**
SEMESTER III							
BT301	Analytical Techniques	2	0	4	6	4	50, 100
BT302	Microbiology & Virology	2	0	4	6	4	50, 100
MB301	Human Genetics	2	0	2	4	3	50, 50
MB302	Human Anatomy & Physiology	3	0	2	5	4	100, 50
BI301	Concepts in Bioinformatics	2	0	2	4	3	50, 50
BT304	Biosafety, Bioethics & IPR	2	0	0	2	2	50
HU301	Universal Human Values II	2	1	0	3	3	100
BTAEC301	Aptitude Building-III	0	0	2	2	1	50
	Total	15	1	16	36	24	850
SEMESTER IV							
BT401	Molecular Biology	3	0	4	7	5	100, 100
MB401	Bioprocess Engineering	2	0	4	6	4	50, 100
MB402	Pharmacology & Toxicology	2	0	0	2	2	50

BT404	Immunology	3	0	2	5	4	100, 50
BT405	Developmental Biology	3	0	2	5	4	100, 50
BT406	Animal tissue culture	2	0	2	4	3	50, 50
BTIKS401	Indian Regional Biodiversity	0	1	0	1	1	50
BTAEC401	Aptitude Building-IV	0	0	2	2	1	50
BTOP401 Non-credit mandatory course	Social outreach program/ Science for Society	0	1	0	1	0	Report submission Satisfactory/ Not satisfactory
	Total	**15**	**2**	**16**	**33**	**24**	**900**
	SEMESTER V						
MB501	Biopharmaceuticals	2	0	2	4	3	50, 50
MB502	Genetic engineering	3	0	4	7	5	100, 100
MB503	Tissue Engineering and Transplantation	2	0	2	4	3	50, 50
BI502	Molecular modelling and drug designing	2	0	4	6	4	50, 100
MB504	Disease Biology	2	0	0	2	2	50
BI501	R Programming	1	0	0	1	1	50
MB505/MB 506	**Elective I** MB505 Cancer Biology MB506 Nanomedicine	2	0	0	2	2	50
BTSEC501	Science communication	0	0	2	2	1	50
BTAEC501	Aptitude Building-V	0	0	2	2	1	50
	Total	14	0	16	30	22	900
	SEMESTER VI						
MB601	Biomedical Devices and Instruments	2	0	0	2	2	50
MB602	Artificial Organs and Biomimetics	2	0	0	2	2	50
MB603	Molecular Diagnostics	2	0	2	4	3	50, 50
MB604	Genomics, Transcriptomics &	2	0	4	6	4	50, 100
BI601	Artificial Intelligence	1	0	2	3	2	50,50
HU601	Health Care Law Management	2	0	0	2	2	50
MB605/MB 606	Elective II MB605 Vaccine Technology MB606 Personalized Medicine	3	0	0	3	3	100
BTIKS601	Indian Constitution and Law	1	0	0	1	1	50
BTSEC601	Foreign Language Course German/French/Japanese/Korean/Spanish/ any other (online MOOCs/offline)	2	0	0	2	2	50
BTAEC601	Aptitude Building-VI	0	0	2	2	1	50
	Total	17	0	10	27	22	750
	SEMESTER VII						
MB701	Clinical Trials	2	0	0	2	2	50
MB702	Forensic Biotechnology	2	0	2	4	3	50, 50

MB703	Metabolic Engineering and Systems Biology	3	0	2	5	4	100, 50
MB704	Seminars in Medical Biotechnology	2	0	0	2	2	50
MB705/MB 706	**Elective III** MB705 Biomechatronics MB706 Epidemiology and Public Health	3	1	0	4	4	100
BTSEC701	NPTEL/SWAYAM/MOOC online course (Based on the courses offered on the MOOCs platform at that point	2	0	0	2	2	Certified by MOOC
BTAEC701	Aptitude Building-VII	0	0	2	2	1	50
	Total	**14**	**1**	**6**	**21**	**18**	**500**
SEMESTER VIII							
MBMP801	**Research Project/Industrial Training/ Review writing/Entrepreneurship Start-up (5 months)**					**22**	**400**
	TOTAL CREDITS: 174						**5750**

Note 1: As regards the assessment of the students with exceptional achievements/performance in games and sports, performing/ fine arts, Social Work, NCC, or other similar subjects/ category is concerned, the same can be defined/prescribed based on their level of competition (State level/ National level/International level/ Commonwealth/ Olympics/ World Championships etc), the level of representation (District/ State/ National/ International), medal/distinction achieved in team/ individual events, and such exceptional performance shall be treated equivalent to an assessment.

SEMESTER I						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
BS 101	Physics	3	0	2	5	4
BS 102	Chemistry	3	0	2	5	4
BT 101	Electronics & Instrumentation Engineering	2	0	2	4	3
BI 101	Python for Biologists	2	0	4	6	4
HU 101	Communication Skills	1	1	0	2	2
BS 103	Maths I – Mathematics	2	0	0	2	2
BTAEC101 (Ability Enhancement)	Aptitude Building-I (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
Total		**13**	**1**	**12**	**26**	**20**

COURSE: PHYSICS

COURSE CODE: BS 101 **L T P H C**

MARKS: 150 (Theory 100 + Practical 50) **3 0 2 5 4**

OBJECTIVES:

- 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.

COURSE OUTCOME

At the end of the course, the learner should be able to:

CO No.	At the end of the course, the learner should be able to:
BS 101.1	Restate the fundamentals of optics and its usage in various biological instrumentation and analysis
BS 101.2	Comprehend the principles and applications of thermometry
BS 101.3	Apply the concepts of surface tension, viscosity, semiconductor devices in real life
BS 101.4	Categorize materials on the basis of elastic and solid state properties
BS 101.5	Determine and explain the properties of laser and sound
BS 101.6	Demonstrate the applications of modern physics in biological sciences

PREREQUISITES

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

COURSE DESCRIPTION

Unit	Topics	Detailed 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 'η' by falling sphere method.	07
4	Elasticity	Stress and Strain, Hook's law, Stress-strain curve, Young's modulus, Determination of Young's modulus.	03
	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
5	Introduction to Digital Electronics:	Introduction to Binary mathematics, BCD numbers, Basic logic gates, De-Morgan's Theorem	02
	Lasers	Properties of Lasers, Production mechanism, Ruby Laser, Helium Neon Laser, applications of Lasers.	03
	Sound waves	Types of sound waves (Longitudinal and Transverse), Audible, Ultrasonic and Infrasonic waves, Beats, Doppler effect, Applications of Ultrasonic waves.	03
	Electricity	Heating effect of electric current, Joule's law, Transformers, Types of Transformers.	02

6	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
Total Number of Lectures			**45**

METHODOLOGY

The course will be covered through lectures supported by practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		100

PRACTICAL IN PHYSICS (2 HOURS PER WEEK) MARKS 50

The practical training would be in the area of optics, electronics, thermometry, calorimeter, conductivity, measurement of physical properties as: viscosity and surface tension.

LIST OF EXPERIMENTS

1. Diffraction Grating: Use of diffraction grafting for determination of wavelength of spectral lining.
2. Resolving Power: To determine the resolving power of Microscope or telescope.
3. Diode Characteristics: Study of forward and reverse characteristics of Diode.

Transistor Characteristics: Study of characteristics of Photocell.

4. Band gap of semiconductor: Study of input and output characteristics of a transistor and determination of band gap of a semiconductor.
5. Ultrasonic Interferometer: Determination of velocity of ultrasonic waves by ultrasonic
6. Study of logic gates (OR, AND, NOT).
7. Thermocouple: Study of variation of thermo emf (electromotive force) with temperature.
8. Surface Tension: Determination of the surface tension of a given solution.

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

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

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

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

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

BOOKS RECOMMENDED:

1. Organic Chemistry by R. T. Morrison and R. N. Boyd, 7th Edition, Prentice Hall, 2011.
2. Organic Chemistry by I. L Finnar, 6th Edition Pearson Publications, 2002.
3. Physical Chemistry by A. Peter and P. Julio De 7th Edition, Oxford University Press, 2010.
4. Essentials of Physical Chemistry by B.S. Bahl & A. Tuli, S Chand & Co. 2000.
5. Biophysical Chemistry by A. Upadhyay, K. Upadhyay & N. Nath., Himalayan Publishing House. 2005.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 101.1	1	2	1	1	2	1	-	-	2	1	-	-	1	-	-
BS 101.2	1	1	1	1	1	1	-	-	1	1	-	-	1	-	-
BS 101.3	2	1	1	1	2	1	1	1	1	1	-	1	1	1	-
BS 101.4	2	2	1	1	1	1	-	-	-	1	-	1	1	1	-
BS 101.5	2	1	1	1	1	1	1	1	1	1	-	1	1	1	-

COURSE: CHEMISTRY

COURSE CODE: BS 102 **L T P H C**

MARKS: 150 (Theory 100 + Practical 50) **3 0 2 5 4**

OBJECTIVES:

- The objective of this course is to familiarize the student with the different concepts of physical and organic chemistry.
- The students will learn the structures of organic molecules as: alkanes, alkenes, alkynes, aliphatic and aromatic molecules and the stereochemistry behind the molecules with its importance in day today life
- They would learn the Basic concepts and principles with respect to physical chemistry, the bioenergetics of different reactions and the principles and applications of radioactivity.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BS 102.1	Classify chemical structures of hydrocarbons
BS 102.2	Determine the stereochemistry of organic molecules and assess their importance
BS 102.3	Identify and compare electrophilic and nucleophilic reactions
BS 102.4	Explain the concept of osmosis, viscosity, colloids, and prepare buffers for any biological system
BS 102.5	Outline and apply the principles of thermodynamics in biological processes
BS 102.6	Apply the knowledge of radioactivity and radioactive isotopes in biological and medical research and diagnosis

PREREQUISITES

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

Course Description

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to organic chemistry	Functional groups, Chemistry of alkanes, alkenes, alkynes, aromatic, alicyclic and heterocyclic compounds	7
2	Stereochemistry	Stereoisomers, Enantiomers, Chiral centers/ Optical activity, Geometric isomers Meso- isomers, Conformational isomers, Stereochemistry of Cyclic Aliphatic compounds,	8
3	Reaction mechanisms	Nucleophilic (SN1, SN2 , Electrophilic E1 and E2)	3

4	Basic concepts and principles of Physical Chemistry	Osmosis- Diffusion, Osmotic Pressure, Theories of Osmosis. Viscosity –Introduction & Types of viscometer. Colloids-Lyophilic & Lyophobic sols, Optical properties, Electrical properties of sols, Gold number. Donnan Equilibrium. Phase rule-Phase, Components & Degree of freedom. Derivation of Phase rule. Phase diagram. Water system. Acid-bases- Three concepts of acids & bases, pH meter & types of electrodes, Buffer solution, Acid base indicator, Law of mass action, Numerical.	11
5	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	6
6	Basic principles of radioactive isotopes	Isotopes in Biology- Properties, Half-life, Radioactive decay. 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. Use of Isotopes-Tritium, Iodine-131, Nitrogen-15, Oxygen-18, Carbon-14, Phosphorus-32, Sulphur-35.	9
Total Number of Lectures			**45**

Methodology

The course will be covered through lectures, demonstration and practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

6. Organic Chemistry by R. T. Morrison and R. N. Boyd, 7th Edition, Prentice Hall, 2011.
7. Organic Chemistry by I. L Finnar, 6th Edition Pearson Publications, 2002.
8. Physical Chemistry by A. Peter and P. Julio De 7th Edition, Oxford University Press, 2010.
9. Essentials of Physical Chemistry by B.S. Bahl & A. Tuli, S Chand & Co. 2000.
10. Biophysical Chemistry by A. Upadhyay, K. Upadhyay & N. Nath., Himalayan Publishing House. 2005.

PRACTICAL IN CHEMISTRY (2 HOURS PER WEEK) MARKS 50

1. Acid-Base Titration
2. Back Titration
3. Qualitative Analysis
4. Determination of optical activity using a Polarimeter
5. Viscosity, Osmosis and Diffusion techniques
6. Demonstrate the procedure for determining Melting/Boiling point
7. To determine the pH of a solution using a polarimeter
8. Study of exothermic and endothermic reactions
9. Conductivity meter
10. Determine the heat of combustion of ethyl alcohol
11. Determine the heat of neutralization of strong acid and strong base

PRACTICAL IN CHEMISTRY (2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective
1	Acid-Base Titration	To understand the concept of titration and how to calculate the strength of acid and base.
3	Back Titration	To analyze the concentration of an analyte based upon chemical reaction.
4	Qualitative Analysis	The practical will help in detection of functional groups present in the chemical compound. (Can be combined with other small practicals-at least 4-5 samples)
5	Determination of optical activity using a Polarimeter	Help them to analyze the degree of rotation of plane polarised light
6	Viscosity, Osmosis and Diffusion techniques	To analyze the physical properties of compound by measuring i) hypotonic, isotonic and hypertonic nature ii)thickness, sticky and semifluid consistency
7	Demonstrate the procedure for determining Melting/Boiling point	The practical will teach them how to analyze the transition point from solid to liquid and ii) liquid to vapor phase.
8	To determine the pH of a solution using a polarimeter	It will guide them to measure the pH of a solution in terms of H+ ion concentration and to understand the importance of pH in biological experiments.
9	Study of exothermic and endothermic reactions.	To understand the concept of thermodynamics of reaction based upon the absorption or release of heat energy.
10.	Conductivity meter	Measuring the electrical conductivity of a solution. Applications in hydroponics, aquaculture and freshwater systems
11	Determine the heat of combustion of ethyl alcohol	To measure the amount of heat energy released during a chemical reaction.
12	Determine the heat of neutralization of strong acid and strong base	To measure the change in enthalpy in a neutralization reaction to form water and a salt.

BOOKS RECOMMENDED:

1. Practical Organic Chemistry: Qualitative Analysis by S.P. Bhutani, A.Chhikara, ANE Books, 2009.
2. Laboratory Manuals In Biochemistry by J. Jayaraman, New Age International Private Ltd., 2000.
3. Experimental Physical Chemistry, By V. D. Athawale, P. Mathur, New Age International Private Ltd., 2000.
4. College Practical Chemistry, By V. K. Ahluwalia, S. Dhingra, Universities Press, 2005.

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 102.1	3	1	1	1	-	1	-	-	1	1	-	-	3	2	1
BS 102.2	3	2	1	1	-	1	-	-	-	1	-	2	1	3	1
BS 102.3	3	2	1	1	-	1	1	-	1	1	-	2	3	1	1
BS 102.4	3	2	1	2	2	1	1	1	1	1	1	2	3	1	1
BS 102.5	3	2	1	1	1	1	1	1	1	1	1	2	3	1	1
BS 102.6	3	1	1	1	1	1	2	2	1	1	1	2	2	2	3

COURSE: ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE CODE: BT 101 **L T P H C**

MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVE:

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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 101.1	Outline the basic concepts of electronics and semi-conductor devices
BT 101.2	Demonstrate the different applications of linear integrated circuits
BT 101.3	Examine and classify various digital electronic components for circuit designing
BT 101.4	Illustrate the working of temperature and pressure transducers

PREREQUISITES:

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Basics	History and scope of electronics, Electrical signals, passive electronic components, resistors, capacitors, inductors, Bio signals	2
	Semiconductor devices	Diode circuits, P-N junction diode, biasing, half wave and full wave rectification	2
2	Linear integrated circuits	Introduction to operational –amplifiers, characteristics of op-amp, virtual short and virtual ground, concept of feedback, inverting and non-inverting amplifier, applications of op-amp, addition, subtraction, integration, and differentiation	8
3	Digital electronics	Digital circuits, AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Boolean algebra, half adder, full adder, multiplexers and de-multiplexers, flip-flops, shift registers, counters, block diagram of microprocessor and microcontroller	8
4	Basic instrumentation	Sensors and transducers, basic measurement system, static and dynamic characteristics of an instrument, signal conditioning circuits	6
Total Number of lectures			**30**

METHODOLOGY:

The course will be covered through lectures, demonstration and practicals**.**

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

PRACTICALS ELECTRONICS AND INSTRUMENTATION ENGINEERING (2 HOURS PER WEEK) MARKS 50

1. Study of passive components in electronics Resistors, Inductors, capacitors, relay, switches, transformers and connectors

2. Study of basic electronics measuring instruments DMM, CRO and function generator

3. Study of semiconductor devices, P-N junction Diode. Plot VI characteristics of P-N junction diode

4. Study of operational amplifier

Part I : Op-amp IC741

Part II: Op-amp as inverting and non-inverting amplifier

5. Study of digital logic circuits.

6. Study of pH electrode

7. Study of resistance type temperature transducers

8. Study of conductivity meter electrode

9. Study of 8085 microprocessor

PRACTICALS ELECTRONICS AND INSTRUMENTATION ENGINEERING (2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective	Literature/ Web links for reference and videos
1	Study of passive components in electronics Resistors, Inductors, capacitors, relay, switches, transformers and connectors.	Students should be able to learn different passive components, their classification, symbol, and unit.	Principles of Electronics by V.K.Mehta and R. Mehta, S. Chand, 2005

2	Study of basic electronics measuring instruments DMM, CRO and function generator.	Students should be able to operate CRO, function generator to generate different electrical signals. They should be able to measure Voltage, current, frequency and time period of waveforms.	
3	Study of semiconductor devices, P-N junction Diode. Plot VI characteristics of P-N junction diode.	Students should be able to learn different semiconductor devices like diode, transistors and also working of PN junction diode. They should be able to plot VI characteristics graphs.	
4	Study of operational amplifier Part I : Op-amp IC741 Part II: Op-amp as inverting and non-inverting amplifier.	Students should be able to learn basic working principle of op-amp, pin diagram of IC 741.	
5	Study of digital logic circuits.	Students should be able to learn different logic gates, their truth table and timing diagram.	
6	Study of pH electrode.	Students should be able to understand operation of pH electrode for the measurement of pH.	
7	Study of resistance type temperature transducers.	Students should able to learn working principle of different resistance type temperature transducers like PRT, RTD, Thermistor, thermocouple	Basic electronics by J.S. Katre, Techmax publication, 2014
8	Study of conductivity meter electrode.	Students should be able to understand the operation of the conductivity meter electrode to measure conductivity of a solution.	Theory and applications of conductivity http://www.evisdom.com/
9	Study of 8085 microprocessor.	Students should be able to understand pin diagram, block diagram and architecture of 8085 microprocessor.	http://8085projects.info/

PRACTICAL EVALUATION SCHEME

Examination **Marks**

Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 101.1	3	1	1	1	2	3	2	-	-	3	-	3	2	1	-
BT 101.2	3	2	2	-	3	3	-	-	-	3	-	3	2	2	-
BT 101.3	3	3	3	-	-	3	-	-	-	3	-	-	3	2	-
BT 101.4	3	2	2	2	2	2	-	-	-	3	-	-	2	2	-

COURSE: PYTHON FOR BIOLOGISTS

COURSE CODE: BI 101 **L T P H C**

MARKS: 150 (Theory 50 + Practical 100) **2 0 4 6 4**

OBJECTIVE:

To enable the students understand the basics of Python programming and design scripts for analysis of biological data.

COURSE OUTCOME

CO No.	At the end of the course, the learner should be able to:
BI 101.1	Apply Primitive and Non-Primitive Data types and use conditional statements
BI 101.2	Make use of functional libraries, modules, and platforms
BI 101.3	Apply Regular Expressions and file handling
BI 101.4	Demonstrate the capability of writing in-house scripts and analyze biological data

PREREQUISITES

The course requires the basic knowledge and Understanding of Computer.

COURSE DESCRIPTION

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to computer system and OOP	Basic Computer Architecture, operating systems etc., Feature(s) of object-oriented programming (OOP), Programming Languages used for biological data analysis with their relevance.	4
	Python Programming Fundamentals	A Brief History of Python, Applications areas of Python, Python data types, Python data structures – lists, tuples, strings, dictionaries, sets, type conversion in python, conditions and if statements - if else and elif, standard input & output, Python flow control: For loop, While Loop, Break: Breaking the Loop.	7
2.	Python Functions and Modules	Python functions: string and list operations, list operations – concatenations, splice, add or remove elements, copy etc; Modules and Packages: Importing Modules, writing own modules, Standard library modules, dir () Function, Working with modules like Pandas, Numpy, Scipy etc., Functional Programming features like Lambda, Map, Filter, Reduce.	9
3.	Python Regular Expressions and File Handling	Python regular Expressions – match, substitute, translate, binding operator; File handling in Python – opening a file in read only mode, write mode, append mode, A Special Kind of File: CSV, Functions from the CSV Module.	4
4.	Biological Data analysis: Case studies	Use of Python packages and libraries relevant to the different biological data type, Python web integration -Python-CGI and working on Jupyter Notebook.	6
Total no. of Lectures			**30**

METHODOLOGY:

The course will be covered through lectures, demonstration, and practicals.

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1.Python Programming for Beginners. Code One Publishing. 2023. ISBN-13:979-8361503742

2.Python Crash course,3rd Edition –December 2022,552pp A Hands-on, Project Based Introduction to Programming by Eric Matthes

3.Conceptual Programming with Python By Thorsten Altenkirch and Isaac Triguero, 2020, ISBN :9780244277567

4.Python for Bioinformatics By Sebastian Bassi 2nd edition,2017, ISBN-10 1138035262, ISBN-13 978-1138035263

5.Python for Bioinformatics By Sebastian Bassi 2nd edition 2018

6.Advanced Python for Biologists by Martin Jones ,2014, ISBN-10 1495244377, ISBN-13 978-1495244377

7.Martin Jones, PYTHON FOR BIOLOGISTS: A complete programming course for beginners. Createspace Independent Publishing Platform. 2013. ISBN-13: 978-1492346135

PRACTICAL IN PYTHON FOR BIOLOGISTS (4 HOURS PER WEEK) MARKS: 100

1. Installation of Python on Windows desktops

2. Write a python script to take DNA sequence as input and calculate and print the length of input sequence

3. Write a Python script to take DNA sequence as input and convert it into RNA and print the RNA transcript

4. Programs using Decision Controls in C

5. Programs using while, do-while and for Loop

6. Programs using Case Control Structure, odd loop

7. Write a Python script to convert an input DNA sequence into an RNA sequence using the substitute operator

8. Using regular expressions, write a Python script to print the reverse complement of the input sequence

9. Write a Python script to check the quality of primer - length and melting temperature - calculate the melting temperature of an input primer sequence using the formula Tm=4(G+C)+2(A+T)

10. Write a Python script to identify the longest Open reading frame in a given DNA sequence read in all 6 frames

11. Reading a data frame through Pandas and basic biological data analysis using Jupyter notebook

PRACTICAL IN PYTHON FOR BIOLOGISTS (4 HOURS PER WEEK) MARKS: 100

Sr. No.	Practical Name
1	Installation of Python on Windows desktops
2	Write a python script to take DNA sequence as input and calculate and print the length of input sequence
3	Write a Python script to take DNA sequence as input and convert it into RNA and print the RNA transcript
4	Programs using Decision Controls in C
5	Programs using while, do-while and for Loop
6	Programs using Case Control Structure, odd loop

7	Write a Python script to convert an input DNA sequence into an RNA sequence using the substitute operator
8	Using regular expressions, write a Python script to print the reverse complement of the input sequence
9	Write a Python script to check the quality of primer - length and melting temperature - calculate the melting temperature of an input primer sequence using the formula Tm=4(G+C)+2(A+T)
10	Write a Python script to identify the longest Open reading frame in a given DNA sequence read in all 6 frames
11	Reading a data frame through Pandas and basic biological data analysis using Jupyter notebook.

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BI 101.1	1	1	-	-	-	-	-	-		-	-	-	1	-	-
BI 101.2	1	1	-	-	-	-	-	-	1	-	-	-	1	-	-
BI 101.3	1	1	-	-	-	-	-	-		-	-	-	1	-	-
BI 101.4	1	1	1	-	1	1	-	-	1	-	1	-	1	-	-

COURSE: COMMUNICATION SKILLS

COURSE CODE: HU-101 **L T P H C**

MARKS: 50 (Theory only) **1 1 0 2 2**

OBJECTIVES:

- 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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
HU 101.1	Display skills in different and appropriate ways of communication
HU 101.2	Proficiently compose well-structured and coherent documents such as emails, reports and essays
HU 101.3	Demonstrate competence in verbal skills and different types of documentations like scientific report writing and research papers
HU 101.4	Follow ethical practices of communication

PREREQUISITES:

This is an introductory course and there are no prerequisites.

COURSE DESCRIPTION

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to communication	Elements, definitions Scope of communication and communication as part of science	02
2	Communication elements	Verbal and nonverbal communications. Principles of effective communication, Oral presentations, Barriers to communications, Use of good English: Introduction to English Grammar: parts of speech, use of articles & prepositions, use of correct tense, spellings etc.	03
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	07
4	Plagiarism	Introduction to Plagiarism	03

		Examples of Plagiarism	
Total Number of Lectures			**15**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Technical Writing and Professional Communication by T. N. Huckin and L. O. London, William Collins and Sons, 1990.

2. Business English and Communication- By L. Clark and Zimmer, New York Mcgraw Hill, 1990.

3. Developing Communications by K. Mohan and M. Banerji, Macmillan India Limited, 2000.

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
HU 101.1	-	-	-	-	2	-	-	1	2	3	2	3	-	-	1
HU 101.2	-	-	-	-	2	-	-	-	2	3	1	3	1	1	1
HU 101.3	-	-	-	-	1	-	-	-	2	3	2	3	1	1	2
HU 101.4	-	-	-	-	2	-	-	-	3	3	2	3	1	1	3

COURSE: Maths I - MATHEMATICS
COURSE CODE: BS-103 **L T P H C**
MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVE:

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

COURSE OUTCOME
At the end of this course, students will be able to:

CO No.	At the end of the course, the learner should be able to:
BS 103.1	Recall the basics of logarithms and binomial expansions
BS 103.2	Explain various trigonometric functions and their factorization
BS 103.3	Define various mathematical functions and evaluate their limits
BS 103.4	Discuss the concepts of derivatives and their applications
BS 103.5	Apply the fundamentals of integral calculus to determine area and volume
BS 103.6	Analyse various types of differential equations

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.

Unit	Topics	Detailed syllabus	No. of Lectures
1	Algebra :	Logarithms: Definition of Logarithm (Natural and common logarithm, Laws of Logarithm. Binomial Theorem: Definition of factorial notation, permutation & combinations, Binomial Theorem for positive index. General term, middle term, Binomial theorem for any index Binomial Theorem for Approximation	06

2	Trigonometry	Trigonometric Ratios (t-ratios): t-ratios of any angle, Relation between t-ratios, Fundamental identities, Quadrants sign of T-ratios in various quadrants, T-ratios of negative angles T-ratios of Allied, Multiple and Submultiples angles, Factorization formulae, Defactorization formulae. Inverse Trigonometric Functions: Definition of Inverse t-functions	03 08
3	Function and Limit	Function: Definitions of variable, constant, intervals such as open, closed, semi-open etc., Definitions of function, value of function, domain & range of a function. Limits: Concepts and definition of Limit, Limits of algebraic functions, trigonometric functions, exponential functions, logarithmic function	02 06
4	Derivatives	Derivatives: Definition of Derivatives, notations, Rules of Derivatives (without proof), Derivatives of composite functions, Derivatives of Inverse trigonometric function by substitution method, Derivatives of Implicit functions, Logarithmic differentiation, Second order differentiation Application of Derivatives: Geometrical meaning of the derivatives, Equations of Tangent & normal to the given curve, Maxima & Minima.	05 04
5	Integration	Integration: Definition of integration, Integration of Standard function; Rules of Integration, Integration of rational functions; Trigonometric functions to determine constant of Integration. Definite Integration: Definition of Definite integral, definite, Definite integral with simple problems Application of Definite Integrals: Area under the curves, Area between two curves.	03 02 02
6	Differential Equation (D.E.)	Definition of D.E., order & degree of D.E., formation of D.E for function containing single constant. 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.	03
Total Number of Lectures			**44**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Internal*	45 minutes	15
Attendance		05
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1) Mathematics for Biological Science by J. Arya & Ladner, Prentice Hall, 1979.

2) Numerical methods by E. Balguruswamy, Tata Mc Graw Hill Publications Pvt Ltd., 1999.

3) Higher Engineering Mathematics by B. S. Grewal, Khana Publication, New Delhi, 2003.

4) Applied Mathematics by P. N. Wartikar, Pune Vidaypeeth, Griha Prakashan, Pune, 2010.

5) Introductory Methods of Numerical analysis by S. S. Sastry, Prentice Hall of India, New Delhi. 2005.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 103.1	3	3	2	-	-	-	-	-	-	1	-	-	1	2	-
BS 103.2	3	3	2	-	-	-	-	-	-	1	-	-	1	2	-
BS 103.3	2	1	2	-	-	-	-	-	-	1	-	-	1	1	-
BS 103.4	2	1	1	-	-	-	-	-	-	1	-	-	1	2	-
BS 103.5	3	2	2	-	-	-	-	-	-	1	-	-	1	2	-
BS 103.6	3	3	3	-	-	-	1	-	-	1	-	-	1	2	-

COURSE: APTITUDE BUILDING -I

COURSE CODE: BTAEC101 **L T P Hr C**

MARKS: 50 **0 0 2 2 1**

OBJECTIVES:

1. To enhance the logical reasoning skills of the students and improve problem-solving abilities
2. To strengthen the ability of solving quantitative aptitude problems

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC101.1	Learn to defend and critique concepts of logical reasoning
BTAEC101.2	Develop expertise in solving problems of quantitative Aptitude
BTAEC101.3	Develop technical skills
BTAEC101.4	Develop analytical understanding

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	No. of Lectures
1	Lessons on Excellence	02
2	Thinking Skill	02
3	Logical Reasoning	04
4	Puzzle solving	02
5	Attention to detail	02
6	Quantitative Aptitude	06
7	Technical Sessions on Biophysics	02
8	Technical Sessions on Chemistry and Biochemistry	02
9	Technical Sessions on Electricity and Biological System	02
10	Competitive Examination Preparation	02
11	Mock Interviews	02
12	Discussion session-Industry Experts/Academia Experts/Alumni	02

	TOTAL	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Continuous Internal Assessment		20
Attendance		
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

BOOKS RECOMMENDED:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing

2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd. Reference Book(s):

3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
BTAEC101.1	-	1	1	-	1	-	-	-	-	-	-	1	2	-	-
BTAEC101.2	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
BTAEC101.3	1	1	1	-	1	-	-	-	-	-	-	-	1	-	-
BTAEC101.4	1	1	1	-	1	-	-	-	-	-	-	-	1	-	-

SEMESTER II						
Course Code	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
MB 201	Medical Biochemistry	3	0	4	7	5
BT 202	Cell Biology	3	0	2	5	4
BS 201	Maths II -Statistics	2	0	2	4	3
BT 203	Engineering Mechanics	2	0	2	4	3
BS 202	Environmental Sciences	2	0	2	4	3
BT 204	Engineering Graphics	1	0	2	3	2
HU 201	Disaster Management*	0	1	0	1	-
BTIKS201 (Indian Knowledge Systems)	History of Indian Science	1	0	0	1	1
BTAEC201 (Ability Enhancement)	Aptitude Building-II (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
Total		**14**	**1**	**16**	**31**	**22**
Audit course, attendance is must						

COURSE: MEDICAL BIOCHEMISTRY

COURSE CODE: MB 201	**L**	**T**	**P**	**Hr**	**C**
MARKS: 200 (Theory 100 + Practical 100)	**3**	**0**	**4**	**7**	**5**

OBJECTIVE:

To familiarize the student with basic biochemistry involved in human metabolism.

COURSE OUTCOME:

On successful completion of the course, students will:

CO No.	At the end of the course, the learner should be able to:
MB 201.1	Classify carbohydrates based on their structure and function and comprehend the clinical significance of carbohydrate metabolism
MB 201.2	Categorize lipids, comprehend lipid metabolism and evaluate the errors in cholesterol metabolism
MB 201.3	Illustrate the structural organization of proteins, plasma proteins and their medical relevance
MB 201.4	Interpret the role of enzymes in metabolic and other cellular processes
MB 201.5	Classify and infer the role of vitamins and explain the role of hormones
MB 201.6	Describe the structure of purines, pyrimidines, DNA, and RNA

PREREQUISITES

Basic knowledge of organic chemistry is required.

COURSE DESCRIPTION

Unit	Topics	Detailed syllabus	No. of Lectures
1	Carbohydrates Properties and Metabolism	Classification and biochemical importance, chemistry and functions of Monosaccharides, disaccharides and polysaccharides including Glycosaminoglycans (Mucopolysaccharides). Synthesis and break down of glycogen, glycolysis, gluconeogensis HMP shunt pathway and its biological significance, pathway. Metabolism of Galactose and Galactosemia. Blood sugar level and its regulation, oral GTT and glycosuria, Biochemistry of diabetes mellitus.	10

2	Lipids	Classification and biological importance of Triacyl glycerol,\ phospholipids, glycolipids, fatty acids (PUFA), steroids and lipoproteins. Biochemical aspects of digestion and absorption of lipids. Beta oxidation, biosynthesis of saturated fatty acids. cholesterol biosynthesis, role of HDL & LDL. Role of ketone bodies. Errors in cholesterol metabolism.	10
3	Proteins	General nature and classification of amino acids. amino acids, biologically important peptides, classification, properties and biological importance of proteins. Structural organization of proteins, plasma proteins and their clinical significance. Biochemical aspects of digestions and absorption of proteins. Fate of amino acid in the body (Deamination, Transmination), Urea cycle. Metabolism of aromatic and their inborn errors.	10
4	Enzymes	General nature, classification, specificity and mode of action of enzymes, factors affecting enzyme activity. Clinical importance Diagnostic, therapeutic) of enzymes.	05
5	Vitamins Hormones	General nature, classification and clinical importance. General characteristics and Mechanism of hormone action (Steroid and Thyroid hormones), cAMP and Ca^{++}-the second messenger.	02 05
6	Nucleic acid	Structure of purines, pyrimidine, structure of DNA and RNA,	03
Total Number of Lectures			**45**

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.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. The principles of Biochemistry by A. Lehninger, D. Nelson, and M. Cox, 5th edition, M. W.H. Freeman and Company, New York, 2008.
2. Metabolic Pathways by D. M. Greenberg, 3rd edition, Academic Press, Elsevier Science & Technology Books, 2014.
3. Biochemistry by L. Stryer, 4th edition, W.H. Freeman and Company, New York, NY, 1995.
4. Biochemistry by J. M. Berg, J. L. Tymoczko, L. Stryer, 6th edition, W.H. Freeman and Company, New York, NY, 2007.
5. Biochemistry by G. Zubay, Addison-Wesley Educational Publishers Inc, 1983.
6. Outlines of Biochemistry by E. Conn and P. Stumpf, 5th edition, John Wiley & Sons, 2009.
7. Principles of Biochemistry by D. J. Voet, J. G. Voet, C. W. Pratt, 3rd edition, (International Student Version), John Wiley and Sons, Inc., 2008.

PRACTICALS IN MEDICAL BIOCHEMISTRY (4 HOURS PER WEEK) MARKS: 100

1. Preparation of buffers

2. Verification of Beer

Lambert's law and determination of λmax by colorimetric method

3. Quantitative estimation of proteins using using Biuret/ Lowry method

4. Determination of blood glucose by GOD/POD method

5. Estimation of serum alkaline phosphatase

6. Determination of serum urea by DAM method

7. Estimation of serum cholesterol by enzymatic method

8. Determination of serum level of Alanine aminotransferase (SGPT) by DNPH method

9. Estimation of Bilirubin – Total and Direct by DMSO method

10. Estimation of serum albumin by BCG method

PRACTICALS IN MEDICAL BIOCHEMISTRY (4 HOURS PER WEEK) MARKS: 100

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	Preparation of buffers.	To understand the concepts of Normality, Molarity, Molality and ppm.	An Introduction to Practical Biochemistry by David T. Plummer, 3 rd ed., Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2	Verification of Beer Lambert's law and determination of λmax by colorimetric method.	To understand the basic principles of colorimetry	An Introduction to Practical Biochemistry by David T. Plummer, 3 rd ed., Tata McGraw Hill Education Private Limited, New Delhi, 2011.

3	Quantitative estimation of proteins using using Biuret/ Lowry method	To understand the bio-chemical properties of proteins. To understand the methods for quantification of proteins in mg/µg	Lowry OH, Rosebrough NJ, Farr *A L*, Randall R J. Protein measurement with the Folin phenol reagent. J Biol Chem. 1951; 193: 265-275. Shakir, F. K., Audilet, D., Drake, A. J., and Shakir, K. M. (1994) A rapid protein determination by modification of the Lowry procedure. Analyt. Biochem. 216, 232–233.
4	Determination of blood glucose by GOD/POD method	To understand the physiological role of glucose and the method for quantification of blood glucose level	Lloyd JB, Whelan WJ. An improved method for the enzymic determination of glucose in the presence of maltose. Anal Biochem.1969; 30: 467-70. Trinder, P. (1969). Determination of blood glucose using an oxidase-peroxidase system with a non-carcinogenic chromogen. J. Clin. Pathol., 22, 2, 158-161.
5	Estimation of serum alkaline phosphatase.	To analyze the serum level of alkaline phosphatase and its physiological role	Drang F, Dith E, and Rougest C, Methods of Enzymatic Analysis, 1986, Vol 9, pp. 348-362. Rathman and Saxena BB, Methods of Enzymatic Analysis, 1986, Vol 9, pp. 396-404.
6	Determination of serum urea by DAM method.	To measure the serum level of urea and understand its biological significance in diabetic patient.	Determination of Urea in Blood and Urine with Diacetyl Monoxime H. L. Rosenthal, *Anal.Chem.*, 1955, *27* (12), pp 1980–1982.
7	Estimation of serum cholesterol by enzymatic method.	To understand the quantitative method for estimation of serum cholesterol and its correlation with atherosclerosis.	The direct colorimetric determination of urea in blood and urine, S. B. Barker, J. Biol. Chem. 1944, 152:453-463.

8	Determination of serum level of Alanine aminotransferase (SGPT) by DNPH method	To understand the clinical role of Alanine aminotransferase by measuring its serum level in patients with liver disease	Bergmeyer HU, Methods of enzymatic analysis, 2nd Ed, Vol II (1974) Academic Press N.Y. Toro G. and Ackarmann P.G. and 1975, Practical Clinical Chemistry, (Boston: Little, Brown)
9	Estimation of Bilirubin – Total and Direct by DMSO method	To measure the content of billirubin in serum for detection of jaundice	Balistreri WF, Shaw LM. Liver function. In: Tietz NW, ed. Fundamentals of clinical chemistry.3 rd ed. Philadelphia:WB Saunders: 1987:729-761. Tietz NW, ed. Clinical guide to laboratory tests. 3rd ed.Philadephia: WB saunders; 1995:268-273.
10	Estimation of serum albumin by BCG method.	To measure the level of serum albumin by using colorimetric method.	Bonvicini, P., Ceriotti, G., Plebani, M. and Volpe, G. Clin. Chem. 25 : 1459 (1979) Tietz. N.W. Fundamentals of Clinical Chemistry, p. 940. W.B. Saunders Co. Philadelphia, PA. (1987).

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 201.1	3	2	3	3	-	2	-	-	1	2	-	2	2	1	1
MB 201.2	2	3	3	2	-	1	-	-	2	1	-	2	2	1	1
MB 201.3	2	3	3	2	-	1	-	-	1	1	-	2	2	1	1
MB 201.4	1	3	3	3	-	2	-	-	2	1	-	3	2	2	2
MB 201.5	2	3	3	2	-	2	-	-	1	2	-	3	2	1	1
MB 201.6	1	3	3	-	-	-	-	-	2	1	-	2	2	1	1

COURSE: CELL BIOLOGY
COURSE CODE: BT 202 **L T P H C**
MARKS: 150 (Theory 100 + Practical 50) **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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 202.1	Explain the basic cell structure, classification, and pre-cellular evolution of prokaryotic and eukaryotic cells
BT 202.2	Illustrate the instrumentation and application of different types of microscopic techniques to study cell structure
BT 202.3	Outline the structure and function of cell organelles, membrane structures and different transportation models of biomolecules
BT 202.4	Demonstrate cell cycle and division of prokaryotic and eukaryotic cells
BT 202.5	Outline cell signaling molecules and their receptors and illustrate programmed cell death and its significance
BT 202.6	Summarize the importance of stem cells in cell differentiation; aberrant cell division and neoplastic transformation

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction	Pre-cellular evolution: artificial evolution of cells, RNA world hypothesis, Postulates of cell theory, Endosymbiotic theory, Broad classification of cell types, Comparative study on Prokaryotic cell and Eukaryotic Cell (Animal and Plant Cell)	3
2	Methods to study cell structure and function and model organisms used in cell biology	Light Microscopy, Electron Microscopy, Fluorescence Microscopy, Confocal Microscopy, Deconvolution Microscopy, Flow cytometry and Cell sorting, Subcellular Fractionation, Introduction to animal cell, plant cell and virus culture, Immunocytochemistry and immunohistochemistry.	6

		Model organisms: *E. coli, S. cerevisiae, D. discoideum,* Hydra. *C elegans, D. melanogaster,* Zebrafish, *A. thaliana,* etc. Emerging Model Organisms.	
3	Cell surface	Cell wall and extracellular matrix. Cell membrane: Structure and functions, Membrane proteins, lipids and sugar modifications for different membrane types. Ion channels. Transport across the membrane, Exo and Endocytosis Cell to cell interaction.	6
	Structure and function of cell organelles along with difference in membrane composition.	Cytosol, Golgi bodies, ER (smooth and rough), Ribosomes, Cytoskeleton structures (Actin and cell movements, Microtubules and cell division, cytoskeleton dynamics and treadmilling), Nucleus (Structure of nuclear envelop, internal organization, nucleolus), Mitochondria (Structure, respiratory chain complexes, ETC, ATP synthase structure, Mitochondrial biogenesis, maternal inheritance, anterograde and retrograde signaling), Chloroplasts, Lysosomes, Peroxisome. Different diseases in relation to cell organelles.	10
4	Cell division (prokaryotic and eukaryotic) and cell cycle	Fission and fusion, budding. Eukaryotic Cell cycle stages (mitosis and meiosis), Nuclear organization during mitosis, Events of M phase, Regulators of cell cycle, Fertilization, Cell proliferation during development.	5
	Protein transport	Transportation of proteins into the nucleus and mitochondria, Vesicular transportation.	3
5	Cell receptors and signal transduction Programmed cell death and Cellular senescence	Signaling molecules and their receptors. Function of surface and intracellular receptors, Different pathways of signal transduction, Signaling in development and differentiation. Apoptosis (intrinsic and extrinsic pathways), Necrosis, Necroptosis, Autophagy (macroautophagy and microautophagy), Cellular senescence, Methods to study cell death.	4 4
6	Basic Concepts in developmental biology	Cell lineage and cell-cell interaction, Embryonic induction, Types and importance of stem cells, Cell differentiation, Causes of abnormal cell division and neoplastic transformation	4
Total Number of Lectures			**45**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Molecular Biology of the Cell; B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter; 6th Edition, Garland Sciences, 2015.
2. Molecular Cell Biology; H. Lodish, A. Berk, Chris A. Kaiser, Monty Krieger , Anthony Bretscher, Hidde Ploegh, Angelika Amon, Kelsey C. Martin; 8th Edition; 2016
3. The Cell: A Molecular Approach; Geoffrey M. Cooper, Robert E. Hausman; 7th Edition ; Sinauer Associates, Inc., 2015.

PRACTICAL IN CELL BIOLOGY (2 HOURS. PER WEEK) MARKS 50

1. Introduction to the instruments used in cell biology (Microscope, Biosafety Cabinets, Incubators, Centrifuges, Pipettes)

2. Study of different cell types under microscope

3. Slide preparation and staining (plant)

4. Blood Smear Preparation and differential staining

5. Buccal smear – Identification of Barr Body

6. Mitosis in Onion Root-Tip Cells

7. Meiotic cell division in grasshopper testis/Hibiscus flower buds

PRACTICAL IN CELL BIOLOGY (2 HOURS. PER WEEK) MARKS 50

Sr. No	Name of Experiment	Learning objective	References
1.	Introduction to the instruments used in cell biology (Microscope, Biosafety Cabinets, Incubators, Centrifuges, Pipettes)	To get acquainted with the instruments and SOP for the various instruments. This Exercise focuses on how to develop a working knowledge of the microscopes and their uses. Students should identify the different parts of the Microscope and safe handling.	Fundamentals of Light microscopy And electronic Imaging by D. B. Murphy, John Wiley & Sons, Inc., Publication. 2001
2.	Study of different cell types under microscope	Students should be able to differentiate between prokaryote, eukaryote cells Should be able to differentiate between plant and animal cells Should be able to differentiate between cells from different tissues	
3.	Slide preparation and staining (plant)	Cross-sectioning of monocot and dicot plant root, stem and leaf Staining and slide preparation	A Text-Book of Histology Descriptive and Practical. For the Use of Students by A.

		Identification of different anatomical features Preparation of permanent slide	Clarkson, 2nd edition, Science Direct, 2013. Methods in plant histology by C.Joseph, 3rd edition, The university of chicago press Chicago, Illinois, The Baker & Taylor Company, 2007
4.	Blood Smear Preparation and differential staining.	A classical method for identification of blood cell preparation.	Dacie and Lewis Practical Haematology by B. Bain, I. Bates, M. Laffan, 11th edition, Elsevier, 2016.
5.	Buccal smear – Identification of Barr Body	A quick cytological method for identification of sex in mammals- an extreme case of chromosomal condensation.	Cytological Assessment of Barr Bodies Using Aceto-Orcein and Papanicolaou Stains in Buccal Mucosal Smears and Their Sex Estimation Efficacy in an Indian Sample, D. U. Angadi P. V. Hallikerimath and S. Kale, *Acta Cytologica*, 57:516-521, 2013 (DOI:10.1159/000353216)
6.	Mitosis in Onion Root-Tip Cells	To study mitosis using Onion root tip cells.	Science Volume 61 of Methods in cell biology by Conly L. Rieder. Academic Press, 1999.
7.	Meiotic cell division in grasshopper testis/Hibiscus flower buds	To perform Meiotic cell division in the given sample	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 202.1	1	2	3	-	1	1	-	-	-	1	-	-	2	2	2
BT 202.2	3	3	3	-	3	2	-	-	-	2	2	3	2	2	2
BT 202.3	3	3	3	-	3	2	-	-	-	2	-	3	2	2	3
BT 202.4	3	3	3	3	3	2	-	-	-	2	-	3	3	3	3
BT 202.5	3	3	3	3	3	3	-	-	2	2	-	3	3	3	3
BT 202.6	3	3	2	3	3	3	2	3	3	2	-	3	3	3	3

COURSE: Maths II: STATISTICS
COURSE CODE: BS 201 **L T P H C**
MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVE

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

COURSE OUTCOME

CO No.	At the end of the course, the learner should be able to:
BS 201.1	Define determinants and matrices for solving simultaneous equations
BS 201.2	Outline the principles of complex numbers and numerical methods
BS 201.3	Use the set theory, probability and probability distribution for solving statistical problems
BS 201.4	Apply the concept of correlation, regression and various hypothesis testing methods to statistical data

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

Unit	Topics	Detailed syllabus	No. of Lectures
1	Determinant & Matrices:	Determinant: Definition & expansion of determinant of order 2 and 3, Cramer‟s rule Matrices: Definition of Matrix of order mxn and types of Matrices, Algebra of Matrices, Transpose of a Matrix, Inverse of a Matrix by adjoin method, Solution of simultaneous equations	**06**
2	Complex Number:	Definition of Complex number, Cartesian, polar, exponential forms of complex number. Algebra of Complex Number De - Moiyre‟s theorem (without proof) and simple problems.	**03**
	Numerical Methods:	Numerical Solution of Simultaneous Equations: Gauss elimination method Iterative Methods Gauss Seidal and Jacobi‟s Method	03

3	Set Theory and Probability	Set Theory Probability: Definition of random experiments, sample space, events, occurrence of event and types of events, Definition of probability, addition and multiplication theorem of probability. Probability Distribution: Binominal Distribution, Poisson‟s Distribution, Normal Distribution	06
	Statistics	Frequency Distribution Measures of Control tendency (For Raw, Ungroup & group Data) Measures of Dispersion: Rauge, Variance, Coefficient of Cariance, Standard Derivation	01 03 02
4	Correlation & Regression	Correlation & Regression	02
	Hypothesis Testing	ANNOVA, Chi square Test	03
	F-Test	F-Test	01
Total Number of Lectures			**30**

METHODOLOGY

The course will be covered through lectures supported by practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Ravid, R. (2024). ***Practical statistics for educators*. Rowman & Littlefield.**

2. **Dr. S.P.Gupta, 46th Edition,2021,ISBN 93-5161-176-9 .*Statistical Methods***

3. **Bruce, P., Bruce, A., & Gedeck, P. (2020). *Practical statistics for data scientists: 50+ essential concepts using R and Python*. O'Reilly Media.**

4. **S. G. Gupta. 17th edition, Himalaya Publications 2000. *Fundamentals of Statistic***

5. **Van Emden, H. F. (2019). *Statistics for terrified biologists*. John Wiley & Sons.**

PRACTICAL IN Maths II: STATISTICS (2 HOURS PER WEEK) Marks: 50

1. Introduction to statistical computing
2. Exploring statistical packages such as SYSTAT/ SPSS/ SAS
3. Biological data handling in statistical package
4. Data exploration with graphs
5. Computation of measures of central tendency
6. Computation of measures of dispersion
7. Computation of correlation coefficient
8. Curve fitting, construction of regression models and computation of regression coefficient
9. Analysis of variance (ANOVA)

PRACTICAL IN Maths II: STATISTICS (2 HOURS PER WEEK) Marks: 50

Sr. No.	Name of experiment	Learning objectives
1.	Introduction to statistical computing.	Understand concepts and ideas behind mathematical and statistical computing.
2.	Exploring statistical packages such as SYSTAT/ SPSS/ SAS.	Explore statistical package environment: features, workspace, menu, and user interface.
3.	Biological data handling in statistical package.	Recognize the difference between biological and other data.
4.	Data exploration with graphs.	Draw various types of graphs.
5.	Computation of measures of central tendency.	Learn how to compute and interpret various measures of central tendency.
6.	Computation of measures of dispersion.	Learn how to compute and interpret various measures of dispersion.
7.	Computation of correlation coefficient.	Learn how to compute and interpret correlation coefficient.
8.	Curve fitting, construction of regression models and computation of regression coefficient.	Understand data modeling and learn to visualize and measure relationship between variables by constructing various models.

9.	Analysis of variance (ANOVA).	Understand and perform ANOVA test.

References:

1. Fundamental of Statistics by S.C. Gupta, 17th edition, Himalaya Publications, 2000 .
2. Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor, S. Chand Publications, 1987.
3. Fundamental of Biostatistics by B. Rosner, 7th edition, Cengage Learning Publisher, 2010.
4. Biostatistics: Bare essentials by G. R. Norman and D. L. Streiner, McGraw-Hill Medical Publisher, 2014.
5. Statistical methods in Bioinformatics by W. J. Ewens and G. R. Grant, 2nd edition, Springer, 2005.
6. The Practice of Business Statistics (w/CD) by Manish Sharma and Amit Gupta, Khanna Publishing House, 2010

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 201.1	2	2	1	-	1	1	-	-	2	1	-	1	2	1	-
BS 201.2	2	2	2	-	1	2	-	-	-	1	-	1	2	2	-
BS 201.3	2	2	2	1	2	2	-	-	2	2	-	2	2	2	1
BS 201.4	2	2	2	2	2	1	2	-	2	1	1	2	2	2	1

NAME OF THE COURSE: ENGINEERING MECHANICS

COURSE CODE: BT 203	**L**	**T**	**P**	**H**	**C**
MARKS: 100 (Theory 50 + Practical 50)	**2**	**0**	**2**	**4**	**3**

OBJECTIVE:

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

COURSE OUTCOME:

By the end of the course, students will:

CO No.	At the end of the course, the learner should be able to:
BT 203.1	Illustrate various force systems and their impacts using vector algebra
BT 203.2	Analyse the equilibrium of rigid bodies using free body diagram and apply the laws of friction
BT 203.3	Calculate impulse, momentum and impact of elastic bodies using principles of kinematics
BT 203.4	Apply the concepts of mechanics in life sciences

PREREQUISITES:

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

COURSE DESCRIPTION:

Sr. No	Topic	Detailed syllabus	No. of Lectures
1	Basics of Mechanics	Introduction, Units and Dimensions, Laws of Mechanics, Vectors – Victorian representation of forces and moments, Vector operations	3
2	Statics of particles	Principal of statics, force systems, Principle of transmissibility, Resolution and Composition of forces , Resultant of concurrent forces, Moment of a force, Resultant of parallel force system, Couple	6
3	Free body diagram	Free body diagram, Types of supports and their reactions, Requirements of stable equilibrium, Equilibrium of a particle, Equilibrium of a particle in space, Equilibrium of rigid bodies in two dimensions, Equilibrium of rigid bodies in three dimensions, Types of beams-Simple and compound beams	7
	Friction	Frictional Force, Laws of Coulomb friction, Simple Contact friction	3

4	Dynamics kinematics	Basics of Kinetics and kinematics, Relative motion, Newton's Law of Motion, Conservation of energy and Work Energy Equation of particles. Impulse and Momentum, Impact of elastic bodies, Direct central impact and coefficient of restitution	6
	Basics of Biomechanics	Basic concept of Biomechanics, Biomechanics of tissues, muscles, bones and ligaments, Applications	5
Total Number of Lectures			**30**

METHODOLOGY:

The course would be taught through lectures, demonstrations and practicals

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Engineering Mechanics by Sanju Unadkat, Seventh edition,Tech-Max publications, 2012.
2. Engineering Mechanics by H.J. Sawant ,sixth Edition, Technical Publication ,2012.
3. Engineering Mechanics by DS Bedi, MP Poonia, Khanna Publications, New Delhi, 2018.

PRACTICALS IN ENGINEERING MECHANICS (2 HOURS. PER WEEK) 50 Marks

1. Study of different force system

2. Study of Laws of coplanar forces
a) Triangle law
b) Parallelogram law
c) Polygon law

3. Study of equilibrium of forces in space
4. Study of collision of elastic bodies
5. Analysis of compound beam
6. Study of flywheel
7. Study of friction
8. To find coefficient of restitution

PRACTICALS IN ENGINEERING MECHANICS (2 HOURS. PER WEEK) 50 Marks

Sr. No.	Name of the experiment	Learning objective	Literature / Web links for reference and videos
1	Study of different force systems.	Students should able to learn different types of force systems and their visual representation.	● Engineering Mechanics by S. Unadkat, 7th edition, Tech-Max publications, 2012. ● Engineering Mechanics by H.J. Sawant, 6th edition, Technical Publication, 2012.
2	Study of Laws of coplanar forces Triangle law Parallelogram law Polygon law	Students should able to learn and prove 3 different laws for coplanar forces.	
3	Study of equilibrium of forces in space.	Students should able to understand the concept of equilibrium, requirements for stable equilibrium.	
4	Study of collision of elastic bodies.	Students should able to learn law of conservation of momentum and concept of Impact.	

5	Analysis of compound beam	Students should able to identify different supports and their reactions. They should able to draw FBD of simple and compound beams.	
6	Study of flywheel	Students should able to learn basic concepts of dynamics, Moment of inertia.	
7	Study of friction	Students should able to learn basic concept of friction, its types.	
8	To find coefficient of restitution.	Students should able to find coefficient of restitution for different materials.	https://physics.stackexchange.com/questions/172127/the-coefficient-of-restitution-of-a-bouncing-ball

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BT 203.1	3	1	1	1	2	-	-	-	2	-	-	1	2	-	-
BT 203.2	3	2	2	2	1	-	-	-	2	-	-	1	2	2	-
BT 203.3	3	2	2	2	1	-	-	-	2	-	-	1	3	3	3
BT 203.4	3	3	3	3	3	3	1	1	3	3	3	3	1	1	3

COURSE NAME: ENVIRONMENTAL SCIENCE
COURSE CODE: BS 202 **L T P H C**
MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVE:
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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BS 202.1	Demonstrate basic understanding of natural resources, ecosystem, and its structural and functional aspects
BS 202.2	Identify the measures to prevent environmental pollution and design strategies for environment conservation
BS 202.3	Comprehend different socio-environmental issues and explain the dynamics of human population
BS 202.4	Explore environmental problems of local area and suggest sustainable solutions

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

COURSE DESCRIPTION

Sr. No	Topic	Detailed syllabus	No. of Lectures
1	Natural Resources and associated problems	Land, water, food, forest, mineral and energy resources, their use, over-exploitation and conservation.	3
	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.	4
2	Environmental Pollution	Definition, Causes, Effects and control measures of Air, Water, Soil, Noise, thermal and Marine Pollution. Nuclear hazards and Solid waste management. Role of an individual in prevention of Pollution and Pollution case studies	6

	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. Biodiversity act 2002	4 2
3	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	4
	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.	3
4	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	4
Total number of lectures			**30**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Environmental Biology, K. Agarwal, Nidi Publ. Ltd. Bikaner, 2001.
2. The Biodiversity of India, B. Erach, Mapin Publishing Pvt. Ltd., 2002.
3. Hazardous Waste Incineration, R.C. Brunner, McGraw Hill Inc., 1989.
4. Marine Pollution, R.S. Cark, 5th edition, Clanderson press Oxford (TB), 2001.
5. A Textbook of Environmental Science by Rimpi Mehani Ne'e Chopra, Jyotsna, Khanna Publishers, New Delhi, 2017.

6. Environmental Studies by MP Poonia and SC Sharma, Khanna Publishers, New Delhi, 2017.
7. Elements of Environmental Polluton Control by O. P. Gupta, Khanna Publishers, New Delhi, 2016.

PRACTICAL IN ENVIRONMENTAL SCIENCE (2 HOURS PER WEEK) MARKS 50

1. To study physicochemical properties of soil (pH, conductivity, moisture content, carbonate content, salinity, porosity)

2. Identification and enumeration of zooplanktons and phytoplanktons as indicator of water pollution

3. To identify and characterize normal microflora in air, water and soil

4. Determination of MPN from water samples

5. Estimation of chlorine in drinking water using colorimetric method

6. Estimation of relative humidity of the atmosphere

7. Estimation of dissolved oxygen in the given water sample

8. Study the effects of pollutants (e.g., heavy metals) on flora

9. Determination of NO_2 from the atmosphere by Colorimetric method using high volume sampler (Optional)

10. Determination of K_2O value of soil by flame photometer (Optional)

PRACTICAL IN ENVIRONMENTAL SCIENCE (2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1.	To study physicochemical properties of soil (pH, conductivity, moisture content, carbonate content, salinity, porosity)	To know about variations of soil properties and to determine their suitability for a particular purpose	● Soil Analysis by P. C. Bandyopadhyay Gene-Tech books, New Delhi, India. 2007. ● Handbook of Water Analysis by M. L. Leo, S. P. Nollet, S. P. Leen, De Gelder. , 3rd edition, CRC Press, United Kingdom, Publisher: Leen S. P. De Gelder, 2013. ● A Microbiology laboratory Manual by J. G. Cappuccino and N. Sherman, 10th edition, Dorling Kindersley, Pearson Benjamin Cummings, 2014. ● Principles and Practices of air pollution analysis by J. R.
2.	Identification and enumeration of zooplanktons and phytoplanktons as indicator of water pollution	To differentiate polluted and non-polluted sites based on plankton data	
3.	To identify and characterize normal microflora in air, water and soil	To know presence of normal microflora within environment.	
4.	Determination of MPN from water samples	Determine potability of water	

5.	Estimation of chlorine in drinking water using colorimetric method	Understanding of residual amount of chlorine in water as a health hazard	Mudakavi, I K International Publishing House Pvt. Ltd., New Delhi, India, 2010.
6.	Estimation of relative humidity of the atmosphere	To understand relationship between weather and humidity	
7.	Estimation of dissolved oxygen in the given water sample	To understand importance of BOD and COD	
8.	Study the effects of pollutants (e.g., heavy metals) on flora	To understand effect about pollution	
9.	Determination of NO_2 from the atmosphere by Colorimetric method using high volume sampler (Optional)	To understand more about atmospheric condition	
10.	Determination of K_2O value of soil by flame photometer (Optional)	To understand about Quality of soil	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BS 202.1	2	1	2	1	-	3	3	2	2	1	-	-	2	1	2
BS 202.2	2	3	3	3	2	3	3	1	2	2	2	2	2	2	1
BS 202.3	1	2	3	2	1	2	3	2	2	1	2	2	2	2	2
BS 202.4	2	3	3	2	2	2	3	2	1	1	2	3	3	2	2

COURSE: ENGINEERING GRAPHICS

COURSE CODE: – BT 204 **L T P H C**

MARKS: 100 (Theory 50 + Practical 50) **1 0 2 3 2**

OBJECTIVES:

- To Learn basic engineering drawing formats.
- Learn to take data and transform it into graphics drawings.
- Learn to sketch and take field dimensions.

COURSE OUTCOME

CO No.	At the end of the course, the learner should be able to:
BT 204.1	Outline the various drawing formats used in engineering graphics
BT 204.2	Analyse detailed concepts of geometric tools, shapes and procedures
BT 204.3	Sketch various orthographic, auxiliary and isometric projections
BT 204.4	Identify lines and surfaces, interpret various views to apply these concepts in tissue engineering

PREREQUISITES

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1.	Drafting Technology and Introduction to Any Drafting Software/Package	Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances. Symbols used on drawing, surface finish symbols, welding symbols. Advantages of using Computer Aided Drafting (CAD) packages, applications of CAD, basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.	2
2.	Curves used in Engineering Practice	Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Archimedean Spiral, Helix on cone and cylinder.	7

3.	Orthographic Projections	Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic view s by First angle method, Sectional orthographic projections – full section, half section, offset section.	2
	Auxiliary Projections	Auxiliary planes – Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP), symmetrical auxiliary view, unilateral auxiliary view, bilateral auxiliary view.	2
	Isometric Projections	Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, and construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, and Sphere.	3
4.	Interpretation of Given Views/Missing Views	Identification of lines/edges and surfaces, visualization of given orthographic views, adding a missing/third view, adding a sectional view, to convert a given view in to a sectional view.	2
Total number of Lectures			**18**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Elementary Engineering Drawing, by D. Bhatt, 53rd edition, Chartor Publishing house, 2014.
2. Engineering Drawing by P.S. Gill, S.K. KAtaria & sons, 2009.
3. Engineering Graphics and Drafting by P.S. Gill, S.K. KAtaria & sons, 2009.
4. Machine Drawing by N.D. Bhatt, 50th Edition, Chartor Publishing house, 2014.

PRACTICAL IN ENGINEERING GRAPHICS (2 Hrs. PER WEEK) MARKS 50

Five A2 (594X420mm) (Half imperial) size drawing sheet as detailed below:

1. Sheet No. 1: CURVES
   - To draw any four curves mentioned in the detailed syllabus.
2. Sheet No. 2: ORTHOGRAPHIC VIEWS
   - To draw two principal views, one sectional view for two objects.
3. Sheet No. 3: AUXILIARY VIEWS
   - To draw auxiliary views from the given views for any two objects.
4. Sheet No. 4: ISOMETRIC VIEWS
   - Two problems on Isometric views.
   - *(minimum one problem by using CAD software/package)*
5. Sheet No. 5: INTERPRETATION OF GIVEN VIEWS/MISSING VIEWS
   - Two problems on Interpretation of given views.
   - *(minimum one problem by using CAD software/package)*

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 204.1	3	1	-	-	2	3	2	-	1	1	-	1	1	-	1
BS 204.2	3	1	-	-	3	2	1	-	2	2	-	2	2	1	1
BS 204.3	3	2	2	2	3	2	-	-	2	2	-	2	3	3	1
BS 204.3	3	3	3	3	3	3	2	2	2	3	3	3	3	3	2

COURSE: DISASTER MANAGEMENT

COURSE CODE: HU-201 **L T P H C**

MARKS: 50 **0 1 0 1 -**

OBJECTIVES:

- 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 OUTCOME:

CO No.	At the end of the course, the learner should be able to:
HU 201.1	Interpret trends in disasters and their types
HU 201.2	Demonstrate the relationship between vulnerability, disasters, disaster prevention and risk reduction
HU 201.3	Sketch approaches of Disaster Risk Reduction with institutional arrangements
HU 201.4	Demonstrate rudimentary ability to respond to the surroundings with potential disaster response

COURSE DESCRIPTION :

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to Disasters	Concepts and definitions (Disaster, Hazard, Vulnerability, Resilience, Risks)	04
	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
2	Approaches to Disasters Risk reduction	Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, Structural – nonstructural measures, roles and responsibilities of community, Panchayati Raj Institution / Urban Local Bodies (PRIs/ULBs), states, centre and other Satke-holders	08

	Inter-relationship between Disasters and Development	Factor affecting Vulnerabilities, differential impacts, impact of Development project such as dams, embankments, changes in Land-ude etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources	04
3	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
4	Project Work	Field Work, Case Studies	06
Total Number of Lectures			**36**

METHODOLOGY

The course will be covered through lectures, project work & classroom discussion.

EVALUATION SCHEME (THEORY)

This course attendance is mandatory but university examination may not be conducted.

BOOKS RECOMMENDED:

1. Introduction in "Confronting Catastrophe' by A. David Oxford University Press, 2000.
2. Vulnerability in Disaster Discourse, by Andharia J. JTCDM, Tata Institute of Social Science working Paper no. 8, 2008
3. At Risk Natural Hazards, Peoples, Vulnerability and Disasters by Blaikie, P, Cannon T, Davis I, Wisner B, Rutledge. 1997
4. Introduction to International Disaster Management, C. P. Damon, 2007,
5. Disaster Management : A Disaster Manager's Handbook, Carter and Nick, Asian Development Bank, Manila Philippines, 1991.
6. Development and Disasters, Cuny, F., Oxford University Press, 1983.
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, National Disasters Management Policy, 2009.
10. Environmental Knowledge for Disasters Risk Management, A. K. Gupta, S. S. Nair, NIDM, New Delhi, 2011.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU 102.1	1	1	2	-	-	-	-	-	-	-	-	-	-	-	1
HU 102.2	2	-	-	-	-	2	-	1	2	1	-	2	-	-	1
HU 102.3	2	-	-	-	-	3	-	1	1	1	-	2	-	-	1
HU 102.4	2	2	-	-	-	-	2	2	0	2	-	2	-	-	1

COURSE: INDIAN KNOWLEDGE SYSTEM: HISTORY OF INDIAN SCIENCE

COURSE CODE: BTIKS201 **L T P H C**

MARKS: 50 (Theory only) **1 0 0 1 1**

OBJECTIVE:

The objective of the course is to familiarize students with the origin and development of science and technology in India.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTIKS201.1	Learn about science and technology during ancient, mediaeval, colonial and post- independence era of India
BTIKS201.2	Relate remarkable scientific discoveries and inventions by Indian rishis and innovators
BTIKS201.3	Recognize India's contribution in science and technology on a global scenario
BTIKS201.4	Identify notable Indian institutions and visionaries that contributed towards scientific and technological revolutions

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Topic	Detailed syllabus	No. of Lectures
1.	Introduction to Indian Knowledge System (IKS), definition, concept and scope of IKS	1.1 Definition, Concept and Scope of IKS 1.2 IKS based approaches on knowledge paradigms 1.3 IKS in ancient India, *Gurukul* -based education system, *Viharas* and Universities 1.4 Significance of IKS in modern India	2
2.	Science and technology in ancient India	2.1 Diverse scientific fields advanced in ancient India including astronomy, mathematics (geometry, arithmetic, and algebra), engineering, agriculture and medicine; ancient Indian temples: engineering and architectural marvels. 2.2 Notable developments in metallurgy and chemistry: use of copper, iron and bronze in ancient India 2.3 Development of geosciences: geographical concepts in ancient Indian literature	6

		2.4 Hydrology and water resources management in ancient India 2.5 Role of acoustics in Vedic sciences	
3.	Developments in science and technology during medieval India	3.1 Scientific and technological advancements in medieval India; the influence of Islamic and European concepts; advancements in the field of mathematics, astronomy, and medicine. 3.2 Innovations in the field of agriculture: introduction of new crops and irrigation techniques.	2
4.	Scientific advancements in colonial and post-independence era	4.1 Scientific breakthroughs in pre-independent India 4.2 Contributions of Jamshedji Tata and Swami Vivekananda in nation building and scientific innovation. 4.3 Development of research organizations in modern India including CSIR, DRDO; Establishment of Atomic Energy Commission; Developments in space satellites	2
5.	Notable scientists, innovators and visionaries of India: standing on the shoulders of giants	5.1 Philosophy and Literature (e.g., Maharishi Kanad, Pingala) 5.2 Mathematics and Astronomy (Aryabhatta, Bhashkaracharya, Varahamihira and Brahmgupta) 5.3 Medicine and Yoga (Acharya Charak, Susruta, Maharishi Patanjali and Dhanwantri) 5.4 Scientists of Modern India including Srinivas Ramanujan, C V Raman, Jagdish Chandra Bose, S N Bose, Har Gobind Khurana, Homi J Bhabha, Vikram Sarabhai, M Visvesvaraya, Birbal Sahni, APJ Abdul Kalam, Yash Pal, Jayant Narlikar, CNR Rao) 5.5 Women in STEM including Anandibai Joshi, Janaki Ammal, Kamal Ranadive, Rajeshwari Chatterjee, Indira Hinduja)	4
Total Number of Lectures			**16**

METHODOLOGY

The course will be covered through lectures & assignments.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.

Additional Readings:

1. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.
2. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
3. Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
4. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
5. Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.
6. Kak, S.C. (1987). On Astronomy in Ancient India, Indian Journal of History of Science, 22(3), pp. 205–221.
7. Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
8. Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU 102.1	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-
HU 102.2	-	-	2	-	-	1	-	2	-	1	-	-	-	-	-
HU 102.3	1	1	1	-	-	1	1	-	1	-	-	-	-	-	-
HU 102.4	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-

COURSE: APTITUDE BUILDING-II

COURSE CODE: BTAEC201 **L T P Hr C**

MARKS: 50 (Practical only) **0 0 2 2 1**

OBJECTIVES:

- To enhance the logical reasoning skills of the students and improve problem-solving abilities
- To strengthen the ability of solving quantitative aptitude problems
- To enrich the verbal ability of the students for academic purposes

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC201.1	Learn to defend and critique concepts of logical reasoning
BTAEC201.2	Develop expertise in solving problems of quantitative Aptitude
BTAEC201.3	Integrate and display verbal ability effectively
BTAEC201.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact Hours
1	Logical Reasoning	04
2	Reading Comprehension for placements	02
3	Quantitative Aptitude	04
4	Verbal Ability	04
5	Recruitment Essentials	04

6	Accuracy, Precision and Statistical Analysis	02
7	Biology, Engineering and Mechanics	02
8	Engineering Graphics-Anthropometry	02
9	Competitive Examination Preparation	02
10	Mock Interviews	02
11	Discussion session-Industry Experts/Academia Experts/Alumni	02
	Total Number of Practice Hours	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Continuous Internal Assessment		20
Attendance		-
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

BOOKS RECOMMENDED:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing
2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.
3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BTAEC201.1	-	1	1	-	1	-	-	-	-	-	-	1	1	-	-
BTAEC201.2	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
BTAEC201.3	1	1	1	-	1	-	-	-	-	1	-	-	1	-	-
BTAEC201.4	1	1	1	-	1	-	-	-	-	-	-	-	1	-	-

SEMESTER III						
BT 301	Analytical Techniques	2	0	4	6	4
BT 302	Microbiology & Virology	2	0	4	6	4
MB 301	Human Genetics	2	0	2	4	3
BI 301	Concepts in Bioinformatics	2	0	4	6	4
BT 304	Biosafety, Bioethics & IPR	2	0	0	2	2
MB 302	Human Anatomy & Physiology	3	0	2	5	4
HU 301	Universal Human Values II	2	1	0	3	3
BTAEC301 (Ability Enhancement)	Aptitude Building-III (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
	Total	**15**	**1**	**16**	**32**	**24**

COURSE: ANALYTICAL TECHNIQUES
COURSE CODE: BT-301 **L T P Hr C**
MARKS: 150 (Theory 50 + Practical 100) **2 0 4 6 4**

OBJECTIVE:
The objective of the course is to create general understanding of centrifugation, chromatographic techniques, various spectroscopic techniques like absorption spectroscopy, fluorescence spectroscopy, Infra-red spectroscopy, Optical Rotatory Dispersion (ORD) & Circular Dichroism (CD) spectroscopy, Nuclear Magnetic Resonance (NMR) Spectroscopy, Electrophoretic techniques, and X-ray crystallography. They would also understand the importance of analytical tools in biotechnology & its applications in various industries.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 301.1	Explore various centrifugation techniques for separation of biological materials at analytical and preparatory level
BT 301.2	Demonstrate the basic and advanced knowledge of various spectroscopic techniques for the analysis of biomolecules
BT 301.3	Employ various chromatographic techniques for purification of biomolecules
BT 301.4	Use different electrophoretic techniques for characterization of biomolecules
BT 301.5	Explain X-ray crystallography for 3D structure determination
BT 301.6	Apply Surface Plasmon Resonance and Isothermal Titration Calorimetry for studying intermolecular interactions

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1.	Centrifugation	Introduction: Basic Principle of Sedimentation Types of centrifuges: Desktop, High Speed and Ultracentrifuge (Preparatory and Analytical), Design and their working principle Types of Rotors, Wall-effect	4
2.	Spectroscopy : (i) Absorption Spectroscopy	Simple theory of absorption of light by molecules, Chromophore and terminologies associated with absorption of molecules The Beer-Lambert Law and its deviations Single and double beam spectrophotometers for measuring Visible and Ultraviolet light: Instrumentation and Parameters measured in absorption Spectroscopy	4

	(ii) Fluorescence Spectroscopy (iii) Infrared Spectroscopy (iv) Optical Rotatory Dispersion (ORD) & Circular Dichroism (CD) (v) Nuclear Magnetic Resonance (NMR) Spectroscopy (vi) Mass spectrometry	Factors affecting the absorption properties of a chromophore Empirical rule for the absorption spectra of biological macromolecules Chemical Analysis by absorption spectroscopy using Visible and Ultraviolet light Structural studies of Proteins using absorption of Ultraviolet light Structural studies of DNA using absorption of Ultraviolet light Simple theory of Fluorescence Instrumentation and Technology of Fluorescence Spectroscopy Intrinsic Fluorescence measurements for information about the conformation and binding sites of proteins Extrinsic fluorescence measurements for information about the conformation and binding sites of proteins Infrared Spectroscopy: Basic Principle Instrumentation and Technology of Infrared Spectroscopy Information in Infrared Spectra and Applications of Infrared spectroscopy Theory of Optical Rotatory Dispersion (ORD) & Circular Dichroism (CD) Relative values of ORD and CD measurements, Advantages of CD over ORD Instrumentation for measuring ORD and CD Applications of ORD and CD Nuclear Magnetic Resonance (NMR) Spectroscopy : Principle Basic Instrumentation of NMR Spectrometer Applications of NMR Spectroscopy Mass spectrometry: Basic Principle Instrumentation and main components of mass spectrometers Ionization source, Mass analyzers, and Detectors 4. Applications of Mass Spectrometry	2 2 2 2 2
3.	Chromatography	Partition Chromatography: Simple Theory, Concept of theoretical plates Adsorption Chromatography: Simple Theory & Types Operations of columns : Terminologies and concept Elution : Types of elution methods Supports : Concept of mesh size and mesh screen Paper Chromatography : Principle, Experimental Procedure, R_f value calculation, Ascending and Descending paper chromatography, 2-D paper chromatography Thin Layer Chromatography: : Principle, Experimental Procedure, R_f value calculation, Advantages of Thin layer chromatography over paper and column chromatography Gas-Liquid Chromatography: Principle, Basic set up of Gas-liquid chromatography system, Detectors and Uses of Gas-Liquid chromatography	10

		Gel Chromatography (molecular-sieve chromatography): Simple Theory, Materials (dextran, agarose and polyacrylamide gels), Advantages of gel chromatography, Estimation of molecular weight and applications of gel chromatography Ion-Exchange Chromatography: Principle, Properties of Ion Exchangers, Choice of Ion Exchangers, Technique and application of Ion Exchange chromatography. High-Performance of Liquid Chromatography (HPLC): Principle, Application of pressure in HPLC, Advantages and uses of HPLC. Affinity Chromatography: Principle, Methods of Ligand immobilization (Cyanogen-bromide-activated agarose, Aminoethyl- and hydrazide-activated polyacrylamide), uses of affinity chromatography	
4.	Electrophoresis	Electrophoresis : General Principle, Agarose and Polyacrylamide gels Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE), Principle of separation, Techniques and molecular weight estimation via SDS-PAGE Iso-electric focusing (IEF): Principle, Technique and application 2-D PAGE: Steps involved in 2-D PAGE, application in proteomics Pulse-field gel electrophoresis: Principle, Technique and Application Capillary electrophoresis: Principle, Technique and Application	4
5.	X-ray crystallography	Interaction of X-ray with matter: Absorption, Scattering and diffraction (Bragg' s Law) Preparation of crystals : Hanging and sitting drop vapor diffusion methods X-ray diffraction methods Application of X-ray Diffraction in Crystal structure	2
6.	Techniques for Intermolecular Interactions	Surface Plasmon Resonance (SPR) Spectroscopy : Principle, Technique & Application Isothermal Titration Calorimetry (ITC) : Principle, Technique & Application	2
		Total Number of Lectures	**38**

METHODOLOGY:

The course will be covered through lectures supported by Practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Physical Biochemistry, Applications to Biochemistry and Molecular Biology, D. Freifelder, 2nd edition, W.H. Freeman and Company, New York, 1992.
2. Biophysical Chemistry Principles and Techniques by A. Upadhyay, K. Upadhyay & N. Nath, 4th edition, Himalayan Publishing House. 2005.
3. Instrumental Methods of Chemical Analysis, G. R. Chatwal and A. K. Sham, 5th edition Himalaya Publishing House, 2005.
4. Instrumental Analysis, D. A. Skoog, F. J. Holler, S. R. Crouch, 11th edition, Brooks/Cole, a part of Cengage Learning, 2012.

PRACTICAL IN ANALYTICAL TECHNIQUES (4 HOURS PER WEEK) MARKS 100

1. Lab orientation, acquaintance with infrastructure and instruments
2. Preparation of various common buffers such as Phosphate buffer saline (PBS), Tris buffer saline (TBS), Tris acetate buffer
3. To study and understand the process of dialysis
4. Separation of various amino acids using paper chromatography and calculation of retention factor (R_f) value
5. Separation of various amino acids using Thin Layer chromatography (TLC) and calculation of Retention factor (R_f) value
6. To study the elution profile of given proteins (e.g. BSA, ovalbumin, lysozyme) on Sephadex G-50 / G-100 column
7. To study and determine the functioning of high performance liquid chromatography (HPLC)
8. Estimation of protein by various methods such as Lowry's and Bradford
9. To find out the concentration of given bovine serum albumin (BSA) solution in mg/ml
10. To estimate the molecular weight of given protein using Sodium dodecyl sulfate - Polyacrylamide Gel Electrophoresis (SDS-PAGE)
11. Centrifugation: Cell pelleting, sub-cellular fractionation of cell extract, handling of various type of centrifuges

Sr. No.	Name of the experiment	Learning objective	Literature/ Web links for reference and videos
1	Lab orientation, acquaintance with infrastructure and instruments.	Developing competence and encourage hands on usage and maintenance of facilities and equipment's. SOPs and safety practices.	1. Physical Biochemistry, Applications to Biochemistry and Molecular Biology, D. Freifelder, 2nd edition, W.H. Freeman and Company, New York, 1992. 2. An introduction to practical Biochemistry, 3rd edition by D. T. Plummer, Tata McGraw-Hill, 2004. 3. Laboratory manual in Biochemistry by J. Jayaraman, New Age International
2.	Preparation of various common buffers such as Phosphate buffer saline (PBS), Tris buffer saline (TBS), Tris acetate buffer	To understand the preparation of various common buffers and its use in biological system, To understand the concept of molarity, normality etc., Measurement of pH, To understand, why a particular buffer is preferred for a particular range of pH	
3.	To study and understand the process of dialysis	Knowhow of preparation and usage of dialysis bag. Application of dialysis process, molecular weight cut off and desalting of proteins. REFER:	
4.	Separation of various amino acids using paper chromatography and calculation of retention factor (R_f) value	To understand the principle of partition chromatography, technique of paper chromatography and calculation of R_f value of given unknown amino acids using the standard amino acids.	

Sr. No.	Name of the experiment	Learning objective	Literature/ Web links for reference and videos
5.	Separation of various amino acids using Thin Layer chromatography (TLC) and calculation of Retention factor (R_f) value	To understand the principle of partition chromatography, techniques of thin layer chromatography and calculation of R_f value of given unknown amino acids using the standard amino acids.	(P) Limited, Publishers, 2011. 4. Introductory Practical Biochemistry by S.K. Sawhney and R. Singh, 2nd edition, Narosa Publishing House, 1999. 5. Calbiochem buffer booklet
6.	To study the elution profile of given proteins (e.g. BSA, ovalbumin, lysozyme) on Sephadex G-50 / G-100 column	1. To know the preparation of the matrix, column packing, calculation of the bed volume, void volume and flow rate etc. 2. To determine the elution profile of given protein by taking absorbance at 280 nm and to understand the principle of molecular- sieving. 3. Various application, desalting, protein separation etc.	
7.	To study and determine the functioning of high performance liquid chromatography (HPLC)	1. To understand the principle of HPLC and functioning of the various parts of HPLC system. 2. To study the elution profile of the BSA using gel filtration column (on TSK-GEL gel filtration column from Tosoh Bioscience)	
8	Estimation of protein by various methods such as Lowry's and Bradford.	To understand the principle of method, preparation of calibration curve with standard protein and calculation of concentration of unknown protein sample.	
9.	To find out the concentration of given bovine serum albumin (BSA) solution in mg/ml.	1. What is percent extinction coefficient? 2. What is the percent extinction coefficient of BSA and standard proteins? 3. How will you calculate the concentration of given protein solution using percent extinction coefficient in mg/ml?	
10.	To estimate the molecular weight of given protein using Sodium dodecyl sulfate - Polyacrylamide Gel Electrophoresis (SDS-PAGE)	1.To study the principle and technique of SDS-PAGE for the separation of proteins 2. To check the purity of the protein using SDS-PAGE 3. Preparation of the standard curve (using standard protein provided) for estimation molecular weight of protein.	
11.	Centrifugation: Cell pelleting, sub-cellular fractionation of cell extract, handling of various type of centrifuges.	1. To understand the basics of centrifugation. 2. Demonstration of various type rotors, their function and use. 3. Demonstration of functioning of various types of centrifuges.	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 301.1	3	3	2	2	2	2	-	-	3	3	3	2	2	1	1
BT 301.2	3	3	2	2	2	2	-	-	3	3	-	3	2	1	1
BT 301.3	3	2	2	2	2	2	-	-	3	3	-	3	2	1	1
BT 301.4	3	3	3	2	2	2	-	-	3	2	-	3	2	1	1
BT 301.5	3	2	3	2	2	2	-	-	-	2	-	2	1	1	1
BT 301.6	3	2	2	1	1	1	-	-	-	2	-	3	1	1	1

COURSE: MICROBIOLOGY AND VIROLOGY

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

MARKS: 150 (Theory 50 + Practical 100) **2 0 4 6 4**

OBJECTIVE:

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

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 302.1	Operate basic and advanced microscopes to identify and differentiate prokaryotes and eukaryotes based on their structure and characteristics
BT 302.2	Demonstrate the processes involved in the replication and survival of bacteria and viruses and their interaction with the environment and hosts
BT 302.3	Employ different methods for controlling the growth of microorganisms in physical and biological settings

BT 302.4	Evaluate microbial diseases and infections in humans and their pathogenesis
BT 302.5	Characterize bacteriophages, plant and animal viruses using basic and advanced methods
BT 302.6	Demonstrate the growth and differentiation of fungi and study their industrial applications

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

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction to Microbiology	Scope and history of Microbiology. Characterization, classification and identification of microorganism. Microscopic examination (Staining and microscopic techniques)	7
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.	7
3	Control of Microorganisms	Control of By physical and chemical agents. Role of antibiotics and chemotherapeutic agents	7
4	Micro –organisms and Human diseases	Multiple drug resistant bacteria and their biofilm lifestyle. Microbial diseases of skin and eye, nervous system, cardiovascular & lymphatic system, respiratory, and digestive system.	5
	The Viruses	Discovery, virus structure, classification, viral replication cycle, detection and enumeration of viruses, virus cultivation in lab, viriods, prions.	5
5	Bacteriophages	Morphology, reproduction of ds DNA phages, ss DNA phages and RNA phages.	4
	Plant Viruses	Nomenclature and classification, viruses infecting fruits and vegetables	4
	Animal Viruses	Viruses containing ss(+) RNA, ss(-) RNA, ds RNA and DNA and ssDNA, RNA tumor viruses requiring DNA intermediate for synthesis.	4
6	The major group of Eukaryotic micro-organism-Fungi.	Growth and differentiation in fungi, Industrial application of fungal cultures.	2
Total Number of lectures			**45**

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1) Microbiology: An introduction, G.J. Tortora, B.R. Funke, C.L. Case, 5th Edition, Benjamin Pub. Co. NY, 1992.
2) Medical Bacteriology, N.C. Dey, and T. K. Dey, Allied Agency, Calcutta, 17th Edition, 1988.
3) Text book of microbiology, R. Ananthnarayana, and C.E, Jayaram Panikar, 5th edition, Orient Longman, 1996.
4) Fields Virology D. Knipe and P. Howley. Vol.1 and 2- 4th Edition. Lippincott-Raven Publishers, 2006.
5) Fundamentals of Molecular Virology, N. H. Acheson 2nd Edition. Wiley Publisher, 2011.

PRACTICAL IN MICROBIOLOGY AND VIROLOGY (2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective
	Introduction to Microscopy	
1	Introduction to Microscopy	a) To study the microscope and to observe different microorganisms like bacteria, protozoa, fungi and yeasts, algae – from natural habitat. b) Demonstration: Students will get familiar with different microscopic techniques such as TEM, SEM, Confocal-Microscopy, Flow cytometry and applications of these microscopic techniques in observation of bacterial biofilms.
	Introduction to Microbiology	
2	Introduction to Microbiology Lab instruments	To understand the principle and use of different microbiology lab instruments such as incubator, oven, colorimeter, autoclave, pH meter, water-bath, analytical balance, biosafety cabinet, refrigerator, deep freezer (-80^{o}C), magnetic stirrer, vortex mixer.
3 (a)	Introduction to Microbiology Lab practices- Preparation and autoclaving of different type lab media	➢ To become familiar with the necessary nutritional and environmental factors for culturing microorganisms in the laboratory. ➢ To understand the decontamination or sterilization process using an autoclave. ➢ To learn the procedures used in preparing media needed for culturing microorganisms.
3 (b)	Preparation of Petri plate and slant. Handling and Examining Cultures	➢ To learn the procedure used in preparing plate and slant for culturing microorganisms. ➢ To make aseptic transfers of pure cultures and to examine them for important gross features.
4	Isolation of bacteria and study bacterial colony characteristics	➢ To isolate pure cultures from a specimen containing mixed flora by using streak and spread plate technique. ➢ To study the different bacterial colony characteristics and to be able to differentiate between the general morphological types of bacteria.
5	Microbial staining techniques- (a) Simple and (b) differential staining	➢ To learn the value of simple stains in studying basic microbial morphology ➢ To learn the Gram-stain technique and to understand its value in the study of bacterial morphology
	Control of Microorganisms	
6	Antimicrobial activity (natural and synthetic) testing using - Disc Diffusion Assay, Well diffusion assay.	To learn the agar disk and well diffusion technique for antimicrobial susceptibility testing of different synthetic drugs and plant derived natural compounds against different Gram positive and Gram negative bacteria.
7	MIC and MBC of antibacterial compounds.	To learn MIC and MBC assay for antimicrobial susceptibility testing of different synthetic drugs and natural compounds against different Gram positive and Gram negative bacteria.

8	Biofilm inhibition activity of synthetic antibiotics and plant derived natural compounds by microtitre plate assay.	To learn the anti-biofilm activity of different drugs against different antibiotic resistance biofilm forming Gram positive and Gram negative bacteria by using crystal violate microtitre plate.
9	Oligodynamic action of heavy metals.	To understand a biocidal effect of metals against different microorganisms, especially heavy metals, that occurs even in low concentrations.
10	Growth curve and how curve is disrupted by an antimicrobial agent.	To understand the growth pattern of bacterial cells and the effect of antimicrobial agents on its growth.
11	Personal Hygiene – Effect of soap and disinfectant washing.	To study the activity of some disinfectants and to learn the importance disinfectant in skin cleaning.
Microbial organisms and diseases		
12 (a)	Isolation, identification of pathogens from clinical samples (urine, stool, pus)	To understand the clinical microbiology (Physical, chemical and microscopic examination of clinical samples). Isolation and identification of pathogens such as *E. coli*, *Salmonella* spp., *Pseudomonas* spp., *Proteus* spp., *Klebsiella* spp., *Shigella* spp., *Staphylococcus*, *Streptococcus* spp., etc.
12 (b)	Demonstration of permanent slides of parasites	To identify and study parasites such as *Entamoeba histolytica*, *Ascaris* spp. *Plasmodium* spp. and *Leishmania* spp.
Mycology		
13 (a)	Distinguish between beneficial and harmful fungi and yeast.	To become familiar with essential and disease causing fungi and yeasts.
13 (b)	Isolation and microscopic observation of fungal cultures.	To become familiar with mycological culture techniques. To visualize and identify the structural components of fungi.
14	Enumeration of yeast cells by Neubaeur chamber. (Source of yeast – Oral thrush or vaginal thrush).	To determine the concentration of yeast cells in a given sample by Neubaeur chamber method.
15	Demonstration of permanent slides – Tissue section with fungal infection.	To become familiar with fungal infection to different human tissue.
Virology		
16	Isolation of bacteriophages by Plaque method	This assay is the most widely used technique for the isolation of virus and its purification, and to optimize the viral titers.
17	Viral infection diagnosis - Cytopathic effect (CPE)	To become familiar with morphological changes in cells caused by viral infections; the responsible virus is said to be cytopathogenic effect.

18	Visit to a viral research institute – such as NARI or NIV, Pune	To become familiar with the research on animal viruses and viral diseases of human Preparation and production of antigens, diagnostic sera, vaccines, nucleic acid probe/s, etc.

References:

1) Basic Practical Microbiology: A manual 2006 Society for General Microbiology (SGM), 2006.
2) Medical Laboratory Technology by K. L. Mukherjee, Vol III, 10th Edition, Tata Mc. Graw-Hill Pub Co., 1988.
3) Antimicrobial Chemotherapy by D. Greenwood, 3rd Edition, Oxford University Press, 1995.
4) Laboratory Manual and Workbook in Microbiology Applications to Patient Care by J. A. Morello, P. A. Granato, and H. E. Mizer, 7th Edition, The McGraw Hill Companies, 2003.
5) Textbook of Medical Laboratory Technology by P. B. Godkar and D. P. Godkar Vol 1 and 2 Bhalani Publishing, 2005.
6) Bergey's Manual of Systematic Bacteriology, Vol 1 and 2 Published by Springer, New York, 2015.

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 302.1	3	2	3	-	3	-	-	-	2	2	-	3	3	1	1
BT 302.2	3	2	3	3	-	2	2	2	2	3	-	3	2	2	1
BT 302.3	3	3	3	3	2	2	2	2	2	2	2	3	2	2	2
BT 302.4	3	2	3	3	2	2	2	3	2	2	2	3	3	3	3
BT 302.5	3	2	3	3	3	2	2	2	2	2	3	3	2	2	2
BT 302.6	2	3	3	2	3	3	3	2	2	2	3	3	3	2	2

COURSE: HUMAN GENETICS **L T P Hr C**
COURSE CODE: MB 301 **2 0 2 4 3**
MARKS: 100 (Theory 50 + Practical 50)

OBJECTIVES:

- The objective of the course is to familiarize the students with the importance & universality of Human Genetics.
- The students would understand Mendelian Genetics & its extensions in relation to human races.
- Students will be acquainted with Non-Mendelian Genetics, Sex Determination, Genetic diseases, Syndromes, Chromosomal Aberrations, and Population Genetics.
- The students will be familiar with sub-disciplines in Genetics and their importance in applied medical sciences.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 301.1	Outline the fundamental principles of inheritance
MB 301.2	Examine the extension and deviations in Mendelian inheritance patterns
MB 301.3	Analyse the chromosomal basis of inheritance, sex determination and the importance of pedigrees and cytogenetics
MB 301.4	Demonstrate the principles of inheritance at the population level, and explain genetic counselling, detection of disorders and the applications of Human Genome Project

PREREQUISITES

Since the course comes under Basic sciences, school level knowledge of molecular biology and chemistry is required by the students to take up this course.

Unit	Topic	Detailed syllabus	No. of Lectures
1	History of Genetics	Historical views of heredity with reference to human genetics	2
	Mendelian Genetics	Mendelian laws and its application Punnett Square and forked line method. Probability Chi Square method. Forward and Reverse Genetics	3

2	Extension of Mendelian laws	Incomplete dominance and co-dominance. Multiple alleles. Gene interactions that modify Mendelian ratios: different types of epistasis, complementation analysis. Environmental effect on the expression of genes. Penetrance and expressivity, Pleiotropy. Position effect and genomic imprinting.	5
	Non-Mendelian inheritance	Rules and examples of Non-Mendelian Inheritance: mitochondrial, chloroplast Maternal and uniparental inheritance. Infectious heredity Maternal Effect	4
3	Chromosomal basis of inheritance	Evidence for chromosome theory of inheritance: Sex chromosomes, Sex linkage and non-disjunction of X chromosomes. Analysis of sex-linked and autosomal traits in humans. Mendelian inheritance in Human ; Pedigree analysis	4
	Cytogenetics and linkage mapping	Cytogenetic techniques. Variations in chromosome structure and number and associated disorders. Linkage and crossing over and gene mapping in eukaryotes.	4
	Sex determination	Genotypic (Mammals, *Drosophila, C. elegans*), genic and environmental mechanisms. Mechanisms of dosage compensation in Mammals, *Drosophila, C. elegans*	4
4	Population genetics	Genetic structure of population: genotype and allele frequencies The Hardy-Weinberg Law. Genetic variation: mutation, migration, natural selection and random genetic drift.	4
	Genetics Counselling and Human Genome Project	Introduction to genetic counselling and ethics, Prenatal and post-natal diagnosis of genetic disorders Online Mendelian Inheritance in Man (OMIM) Introduction to Human Genome Project	3
Total Number of Lectures			**33**

METHODOLOGY

The course would be taught through lectures, demonstrations & tutorials with the help of logical questions and numerical etc**.**

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1.

1. Russell, P. J. (2006). Genetics A molecular approach, Pearson Benjamin Cummings, San Francisco Boston, New York.
2. Tamarin, R. H. (2002). Principles of Genetics 7th edition, The McGraw Hill Companies USA.
3. Klug, W. S., Cummings, M. R. (1999). Essentials of Genetics. Prentice-Hall Inc. USA.

PRACTICAL IN GENETICS (2 HOURS PER WEEK) MARKS: 50

Sr. No.	Name of the experiment	Learning objective	Literature/ Web links for reference and videos
1.	Introduction to different model organisms used in genetic studies (*Escherichia coli, Drosophila melanogaster, Caenorhabditis elegans, Mus musculus, Saccharomyces cerevisiae and Arabidopsis thaliana)*	To understand the importance of model organisms in genetic studies	Pierce B. A. (2013) Genetics- A Conceptual Approach , 5th edition, , W. H. Freeman & CompanyRead and Strachan, T. (2018) Human Molecular Genetics by, 5th edition, Taylor & Francis.
2.	Study the life cycle of *Drosophila* (fruit-flies) and examine *Drosophila* stocks with viable mutations	To recognize different stages of development in flies and familiarize with some of the mutant phenotypes	Greenspan R. J. (2004) Fly Pushing: The Theory and Practice of Drosophila Genetics, CSHL Press.
3.	Analysis of ABO blood groups in human beings	To understand Mendelian inheritance and the concept of multiple alleles	http://nib.gov.in/guidance_document/Guidance_manucal_QC_ ABO_Rh_blood_grouping_26_03_2013.pdf
4.	Monohybrid crosses using the eye-color traits in *Drosophila*	To comprehend sex-linked inheritance with reference to extension of Mendelian principles	
5.	Estimation of gene frequencies in a population	To familiarize with the distribution of dominant and recessive traits in a population, and understand the applications of Hardy-Weinberg law	Pierce B. A. (2013) Genetics- A Conceptual Approach , 5th edition, , W. H. Freeman & Company Read and Strachan, T. (2018) Human Molecular Genetics by A. P.

			Read and T. Strachan, 54th edition, Taylor & Francis., 2011.
6.	Preparation and analysis of human karyograms	To understand the process of karyotyping and preparation of karyograms in order to analyze structural and numerical aberrations	https://labtestsonline.org.au/learning/test-index/chromosome-analysis-karyotyping Read, A. P. and Strachan, T. (2018) Human Molecular Genetics by A. P. Read and T. Strachan, 54th edition, Taylor & Francis., 2011.
7.	Analysis of the skin markings or patterns on fingers and palms (Dermatoglyphics)	To understand polygenic inheritance and correlate the fingerprint and palm patterns with some genetic disorders.	E-MANUAL, Life Sciences Protocol Manual, Published by DBT, Min. of Science and Technology, Govt. of India
8.	Dihybrid or Balanced lethal crosses in *Drosophila* (any one)	To understand: The inheritance of two unlinked traits in flies. or the importance of balanced lethal fly stocks in maintaining deleterious mutations over several generations	Greenspan R. J. (2004) Fly Pushing: The Theory and Practice of Drosophila Genetics, CSHL Press.

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 301.1	1	2	1	-	-	-	-	-	1	1	-	1	1	1	1
MB 301.2	1	2	1	1	1	1	1	0	1	1	-	1	1	1	1
MB 301.3	1	3	1	1	1	1	1	1	1	1	1	1	3	2	2
MB 301.4	1	2	1	1	1	1	1	1	1	1	1	1	3	3	3

NAME OF THE COURSE: CONCEPTS IN BIOINFORMATICS

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

MARKS: 100 (Theory 50 + Practical 100) **2 0 4 6 4**

OBJECTIVE:

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

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BI 301.1	Outline the scope of bioinformatics and use sequence and structural databases
BI 301.2	Identify the data retrieval tools and illustrate respective biological file formats to solve a research problem
BI 301.3	Analyse and interpret nucleotide and protein sequences based on biological tools such as BLAST, FASTA, CLUSTAL Omega
BI 301.4	Predict structures and apply data from secondary databases to assess various biological questions such as evolutionary relationship, structural and functional annotations

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

Unit	Topics	Detailed syllabus	No. of Lectures
1	Overview of Bioinformatics.	Overview and scope of Bioinformatics, Computers in biology, medicine & different problems in biology.	02
	Introduction to nucleic acid and protein databases.	NCBI, EMBL, DDBJ, UNIPROT, PDB, SCOP, CATH.	05
2	Data acquisition, Database content, structure and annotation.	File formats: GenBank, EMBL, PDB, PIR, ALN Types of database: flat file, relational, hierarchical, network, object-oriented. Annotated sequence databases, Genome and Organism specific databases.	03
	Retrieval of Biological Data.	Data retrieval tools: Entrez, SRS etc.	02

3	Pairwise sequence alignment.	Sequence comparisons & alignment concepts, Global Alignments – Needleman-Wunsch Algorithm Local Alignments – Smith-Waterman Algorithm Introduction to Homology, Analogy, Orthology Paralogy, Xenology.	04
	Multiple sequence alignment.	Methods of multiple sequence alignment, CLUSTALW & MUSCLE Algorithms, Applications of MSA.	03
	Database similarity searches.	FASTA, BLAST, PSI-BLAST algorithms.	02
	Patterns, Motifs, and Profiles.	Derivation and searching, Derived Databases of patterns, motifs and profiles Prosite, Blocks, Prints, Pfam etc.	03
4	Introduction to Phylogenetic analysis.	Methods of phylogenetic analysis, cladistics, Building phylogenetic trees, evolution of macromolecular sequences.	03
	Introduction to structural Bioinformatics.	Levels of protein structure, Analyzing secondary structure, Ramachandran Plot, Protein structure prediction, RNA structure prediction, visualization tools.	03
Total Number of Lectures			**30**

METHODOLOGY

The course will be covered through lectures and supported by practical.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED

1. Ramsden, J. (2023). Bioinformatics: an introduction. Springer Nature.
2. Rastogi, S. C., Rastogi, P., & MENDIRATTA, N. (2022). Bioinformatics: Methods and Applications-Genomics, Proteomics and Drug Discovery. PHI Learning Pvt. Ltd.
3. Bioinformatics: Sequence and genome analysis by D. W. Mount, 2nd edition, CBS Publication, 2005.
4. Bioinformatics: Tools & Applications by D. Edward, J. Stajich and D. Hansen, Springer, 2009.
5. Bioinformatics: Databases, Tools & Algorithms by O. Bosu and S. K. Thurkral, Oxford University Press, 2007.
6. Bioinformatics: Methods and Applications - Genomics, Proteomics and Drug Discovery by S.C. Rastogi, N. Mendiratta, P. Rastogi, PHI Learning Pvt. Ltd., 2015.

PRACTICAL IN BIOINFORMATICS (4 HOURS PER WEEK) MARKS: 100

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1.	Introduction to Nucleic Acid and Protein Sequence Data Banks.	Explore and Search Nucleic acid Sequence Database NCBI, EMBL, DDBJ.	www.ncbi.nlm.nih.gov/genbank/ https://www.ebi.ac.uk/embl/ www.ddbj.nig.ac.jp/
2.	Introduction to Protein Sequence Data Banks.	Explore and Search and use analysis tools at Protein Sequence Database: UNIPROT	http://web.expasy.org/docs/swiss-prot_guideline.html http://pir.georgetown.edu/
3.	Database Similarity Searches.	•BLAST •FASTA	https://blast.ncbi.nlm.nih.gov/ https://www.ebi.ac.uk/Tools/sss/fasta/
4	Database Similarity Searches.	PSI-BLAST,PHI-BLAST algorithms	https://blast.ncbi.nlm.nih.gov/
5	Multiple sequence alignments.	Clustering algorithm CLUSTALW, Tree View, MUSCLE	www.genome.jp/tools/clustalw/
6	Patterns, motifs and Profiles in sequences.	Study Derived Databases: PROSITE, BLOCKS, Prints Pfam etc.	https://prosite.expasy.org/prosite_link.html https://www.ncbi.nlm.nih.gov/pmc/articles/PMC102408/
7	Genome Databases.	Ensemble, TIGR, Flymine	http://plantta.jcvi.org/ www.flymine.org/
8	Protein Structure Databases.	PDB, SCOP, CATH	http://www.rcsb.org/pdb/home/home.do scop.mrc-lmb.cam.ac.uk/scop/
9.	Structure Visualization and Manipulation	Structure Visualization Tools: Pymol, RASMOL	https://pymol.org/
10	Data Structure Algorithms	Data Structure Algorithms for gene, protein sequence analysis.	https://www.perl.org/

BOOK RECOMMENDATION:

Bioinformatics: A practical guide to Analysis of Genes & Proteins by A. D. Baxevanis and B. F. Francis Ouellette, 3rd edition, John Willey and sons, 2005

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BS 304.1	3	3	3	-	3	3	-	-	2	2	-	3	1	1	-
BS 304.2	3	3	3	-	3	3	-	-	2	2	-	-	1	1	-
BS 304.3	3	3	3	3	3	3	-	-	2	2	1	2	3	2	2
BS 304.4	3	3	3	3	3	3	2	2	3	3	2	2	3	2	2

COURSE: BIOSAFETY, BIOETHICS & INTELLECTUAL PROPERTY RIGHTS

COURSE CODE: BT 304 **L T P Hr C**
MARKS: 50 (Theory only) **2 0 0 2 2**

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 supposed 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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 304.1	Practice biological risk assessment in a laboratory and implement measures of protection though various levels of biosafety practices
BT 304.2	Outline various national and international guidelines related to biosafety and its implementation in biotechnology
BT 304.3	Comply with bioethical practices in biotechnological research
BT 304.4	Categorize intellectual property into patents, copyrights, Trademarks, Industrial designs, Trade secrets and Geographical Indications

PREREQUISITES:

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures

1	Biosafety	Introduction and Development of Biosafety Practices and Principles 1 General lab requirements Definitions and Biosafety levels: 1,2,3,4 & Summery 2 Biological safety cabinets: centrifuges, Shipment of biological specimens, Biological waste management, Decontamination, Biosafety manuals, Medical surveillance, Emergency response 3 Risks and Assessment of Risks 1 Biosafety at small scale and large-scale processes 1 Biosafety for genetically engineered microbes, plants and animals 1	12
2	Safety Guidlines	National biosafety committees Biosafety and environment protection International conventions	03
3	Bioethics	History and Introduction Ethics and genetic engineering Genetic Privacy Patent of genes Human races, Trading Human Life, Human Cloning Stem Cells, Eugenics, Christian faith, Human genome and religious considerations Case Studies and Final Considerations	06
4	Intellectual Property Rights	Introduction and Types of Intellectual Property Rights Patents Copyrights, Trademarks, Industrial designs, Trade secrets, Geographical Indications and Farmers rights & Plant variety Protection. IPR for Biotechnology, Patenting of transgenic organisms and isolated genes, microbes etc International conventions and cooperation Current status of IPR in India	12
Total Number of Lectures			**30**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Understanding Biotechnology by A. Borem, D. E. Bowen and F. R. Santos, 1st edition, Pearson Education Inc., 2003.
2. Biotechnology an Introduction by S. R. Barnum, Brooks/Cole; International Edition 2004
3. Biosafety and Bioethics by R. Joshi, Isha Books, Delhi, 2006.
4. Introduction to Bioethics by J. A. Bryant and L. B. la Velle Bryant, 1st edition, Wiley Blackwel Publishing, 2005.
5. Intellectual Property Rights by C.B. Raju, 1st edition, Serials Publications, 2007.
6. Law Relating to Intellectual Property by B. L. Wadehra, Universal Law Publishing CO., Fourth Edition, 2007.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 304.1	1	2	2	1	3	3	3	1	1	2	3	2	2	-	3
BT 304.2	1	2	3	2	2	2	3	1	1	2	3	2	2	-	3
BT 304.3	1	2	2	1	1	2	3	3	2	3	2	2	2	1	3
BT 304.4	1	2	2	2	2	2	2	1	2	3	3	1	2	1	3

TITLE OF THE COURSE: HUMAN ANATOMY & PHYSIOLOGY

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

MARKS: 150 (Theory 100 + Practical 50) **3 0 2 5 4**

OBJECTIVES:

- The objective of the course is to develop insight of physiological aspects of the human systems with respect to various interactions occurring with all the major organs of the body.

- The course is well equipped to deal with branches of biophysics, biochemistry and clinical applications as well.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 302.1	Outline the concepts of tissue level organization, feedback cycle in human physiology and discuss the functioning of digestive system
MB 302.2	Explain the various components of cardiovascular system and associated disorders
MB 302.3	Illustrate the functional aspects of respiratory system and associated disorders
MB 302.4	Discuss the anatomy and physiology of excretory system and associated disorders
MB 302.5	Summarize the anatomy and physiology of endocrine and reproductive systems and related disorders
MB 302.6	Examine the anatomy and operations of the nervous system and its associated diseases.

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:

Unit	Topic	Detailed syllabus	No. of Lectures
1	Basic concepts in Human Anatomy and Physiology	Introduction and background. Levels of structural organization, homeostasis (role of body fluids) and control systems	3
	Physiology of Digestive System	Anatomy, histology and physiology of oesophagus, stomach, small intestine, large intestine and accessory organs. Disorders and disease associated with digestive system Digestive system disorders and disease.	6
2	Physiology of Circulatory System	Blood composition, blood pressure, Regulation of the circulation, mean arterial pressure, cardiac output and venous return, circulatory shock and its physiology, cardiac failure, coronary circulation. Hemodynamics	7
3	Physiology of Respiratory System	Anatomy, histology and physiology of respiratory organs. Physical principles of gaseous exchange, transport of O2 and CO2 in the blood and body fluids. Chloride & reverse chloride shift. Disorders associated with respiratory system.	6
4	Body fluids and Kidney - Physiology	Anatomy, histology and physiology of the kidney. Glomerular filtration and tubular function. Regulation of urine concentration and auto regulation.	6
5	Endocrinology	Anatomy, histology and funtion of major endocrine organs. Pituitary, Thyroid gland, adrenal glands and their hormones: functions and disorders. Regulation of insulin, glucagon and related disorders. Parathyroid hormone, calcitonin and calcitrol. Function and regulation of sex hormone: progesterone, estrogen and testosterone	6
	Reproductive System- Physiology	Anatomy, histology and physiology of male and female reproductive organs. Maintenance of female reproductive system and cycle. Sex hormones in puberty, menstrual cycle.	5
6	Nervous System Physiology	Structure and function of sensory receptors. Neural circuits and nerve conduction.	6
Total Number of Lectures			**45**

METHODOLOGY:

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EXAMINATION SCHEME

Examination	Duration	Marks
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

REFERENCE BOOKS

- Textbook of Medical Physiology by Arthur C. Guyton, John E. Hall.Elsevier- Saunders. 11th ed.
- Human Physiology by C. Chatterjee. Arun Printing Works, Calcutta, 2002
- Principles of Anatomy and Physiology (Maintenance and Continuity of the Human Body) by Gerard J Tortora.
- Principles of Anatomy and Physiology: Organization, Support and Movement, and Control Systems of the Human Body, 2 Volume Set by Gerard J. Tortora and Bryan H. Derrickson (Isv 13th Edition). John Wiley and sons. 2011
- Harpers Illustrated Biochemistry 30th Edition by Rodwell, Victor W.and Bender, David. 2015.
- Medical physiology by Chaudhary, 6th Ed. New Central Book Agency.
- Anatomy and histology in Health and Illness, 13th Edition by Ross and Wilson, Elsevier, 2018
- Human Anatomy and Physiology / Edition 2 by Joan G. Creager, McGraw-Hill Professional Publishing, 1991.

HUMAN ANATOMY & PHYSIOLOGY (2 HOURS PER WEEK) 50 MARKS

Sr. No.	Practical Name
1	Demonstration of human cells from slides/charts.
2	Demonstration of various tissues from permanent slides: Epithelial tissue, Connective tissue, Muscular tissue, Nervous tissue
3	Demonstration of individual bone, respiratory system, cardiovascular system and different systems form models and charts.
4	Phenol Red Clearance or intestinal Absorption of Glucose
5	Responses of skeletal muscle to electrical stimulation
6	Electromyography, pulmonary and cardiovascular measurements in humans
7	Electro cardio gram (ECG), Human electrocardiography and renal control of body fluids

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 302.1	3	1	1	-	-	1	-	-	2	3	-	3	2	1	-
MB 302.2	3	1	1	2	-	2	-	-	1	3	-	2	3	2	1
MB 302.3	3	1	1	2	-	2	-	-	1	3	-	2	3	2	1
MB 302.4	3	1	1	2	-	2	-	-	1	3	1	2	3	2	1
MB 302.5	3	1	1	2	-	2	-	-	1	3	-	2	3	2	1
MB 302.6	3	1	1	2	-	2	-	-	1	3	-	2	3	2	1

COURSE: UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

COURSE CODE: HU 301	**L**	**T**	**P**	**H**	**C**
MARKS: 100 (Theory only)	**2**	**1**	**0**	**3**	**3**

HUMAN VALUES COURSES: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

OBJECTIVES:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act

COURSE OUTCOME

CO No.	At the end of the course, the learner should be able to:
HU 301.1	Develop a holistic perspective based on self- exploration about themselves (human being), family, society, nature and existence
HU 301.2	Acquire harmony in the self, family, society and nature
HU 301.3	Strengthen self-reflection and develop commitment and courage to act responsibly
HU 301.4	Utilize the professional competence for augmenting universal human values

PRE-REQUISITES: None. Universal Human Values 1 (Desirable)

COURSE DESCRIPTION

Unit	Topic	Detail Syllabus	No. of Lectures
1	Introduction	Purpose and motivation for the course, recapitulation from Universal Human Values-I. 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels	2

	Understanding Harmony in the Human Being - Harmony in Myself!	Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. 2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). 4. Understanding the characteristics and activities of 'I' and harmony in 'I'. 5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. 6. Programs to ensure Sanyam and Health.	6
2	Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship	Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 2. Understanding the meaning of Trust; Difference between intention and competence 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	6
3	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence	1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3. Understanding Existence as Co-existence of mutually interacting Unit in all-pervasive space. 4. Holistic perception of harmony at all levels of existence.	7
4	Implications of the above Holistic Understanding of Harmony on Professional Ethics	1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible	7

		engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations	
Total Number of Lectures			**30**

TUTORIAL SESSIONS

Unit	Detail Syllabus	No. of Lectures
1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking	2
	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.	3
2	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	3
3	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	3
4	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. to discuss the conduct as an engineer or scientist etc	3
	Total	14

BOOKS RECOMMENDED:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L:1T:0P 3 credits): Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks

Self-assessment: 10 marks

Assessment by peers: 10 marks

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OUTCOME OF THE COURSE: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living. E.g. as a professional

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 301.1	-	-	-	-	-	2	3	3	3	3	-	2	-	-	1
BT 301.2	-	-	-	-	-	2	3	3	3	3	-	2	-	-	1
BT 301.3	-	-	-	-	-	3	2	3	3	2	-	2	-	-	1
BT 301.4	-	-	-	-	-	2	-	3	3	2	-	3	-	-	1
BT 301.1	-	-	-	-	-	2	3	3	3	3	-	2	-	-	1

COURSE: APTITUDE BUILDING-III

COURSE CODE: BTAEC301 **L T P Hr C**

MARKS: 50 (Practical only) **0 0 2 2 1**

OBJECTIVES:

1. To enhance the logical reasoning skills of the students and help them improve the problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC301.1	Exhibit sound knowledge to solve problems of Quantitative Aptitude
BTAEC301.2	Demonstrate ability to solve problems of Logical Reasoning
BTAEC301.3	Display the ability to tackle questions of Verbal Ability
BTAEC301.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact Hours
1	Data arrangements and Blood relations	04
2	Ratio and Proportion	04
3	Percentages, Simple and Compound Interest	04
4	Number System	04
5	Essential grammar for placements	02
6	Electromagnetic Spectrum, Fluorescence and Bioluminescence	02
7	Instrumentation of Microscope	02
8	Morphometry	01
9	Data representation	02
10	Competitive Examination Preparation	02

11	Mock Interviews	01
12	Discussion session-Industry Experts/Academia Experts/Alumni	02
	Total Practical/Training hours	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Continuous Internal Assessment		20
Attendance		
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

BOOKS RECOMMENDED:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing

2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.

3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU 102.1	-	2	2	-	2	-	-	-	-	-	-	2	2	-	-
HU 102.2	1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
HU 102.3	1	1	1	-	2	-	-	-	-	2	-	-	1	-	-
HU 102.4	1	1	1	-	1	-	-	-	-	-	-	-	1	-	-

SEMESTER IV						
BT 401	Molecular Biology	3	0	4	7	5
BT 406	Animal tissue culture	2	0	2	4	3
MB 401	Bioprocess Engineering	2	0	4	6	4
BT 404	Immunology	3	0	2	5	4
BT 405	Developmental Biology	3	0	2	5	4
MB 402	Pharmacology & Toxicology	2	0	0	2	2
BTIKS401 (Indian Knowledge Systems)	Indian Regional Biodiversity (Includes field trips and expeditions)	0	1	0	1	1
BTAEC401 (Ability Enhancement)	Aptitude Building-IV (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
BTOP401 Non-credit mandatory course	Social outreach program/ Science for Society	0	1	0	1	0
	Total	**15**	**2**	**16**	**33**	**24**

COURSE: MOLECULAR BIOLOGY

COURSE CODE: BT 401	**L**	**T**	**P**	**Hr**	**C**
MARKS: 200 (Theory 100 + Practical 100)	**3**	**0**	**4**	**7**	**5**

OBJECTIVE:

The objective of the course is to familiarize the students with the basic concept in molecular biology.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 401.1	Outline the concept of molecular biology and genome organization
BT 401.2	Illustrate the mechanism of DNA damage and repair, and recombination
BT 401.3	Explain and analyse the mechanism of DNA replication
BT 401.4	Summarize the mechanism of RNA transcription and its regulation with detailed understanding of post transcriptional processing
BT 401.5	Apply the knowledge of protein translation and posttranslational modification for understanding cellular functions
BT 401.6	Discuss the regulation of gene expression in prokaryotes and eukaryotes

PREREQUISITES:

Since the course is advance in nature, student must know about biochemistry of nucleic acids, chromosomes and gene structure. Student must have background with Genetics.

COURSE DESCRIPTION:

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction:	Concept of genes, Central dogma of Molecular Biology DNA as the genetic material Structure of DNA and RNA	2
	Genome and its organization:	● Genome, cot analysis, C value paradox, ● Repetitive DNA, Satellite DNA, Gene families and gene clusters ● Nuclear and organelle genome	3
	Chromatin and Chromosome organization:	● Nucleosome structure, Higher order chromatin structure ● Chromosome structure in prokaryotes & eukaryotes	3
2	DNA damage DNA Repair Recombination:	● Types of mutations. Replication errors and their repairs. ● DNA damage ● DNA repair – Single step and multistep	10

		● Models of homologous recombination in eukaryotes and prokaryotes ● Non homologous and end joining (NHEJ) recombination ● Genetic consequences of mechanism of recombination. ● Site specific recombination and transposition of DNA: conservative site specific recombination, biological roles of sites recombination ● Gene conversion.	
3	Replication of DNA	● Models of DNA replication ● Replication fork, continuous and discontinuous DNA synthesis. ● Enzymes and proteins in replication ● Replication of DNA and different models of replication ● Telomeres. Inhibitors of DNA replication.	5
4	Transcription and mRNA processing, maturation	● Components of transcriptional machinery in prokaryotes and eukaryotes: Promoters and Enhancer sequences and transcription units ● RNA polymerases - E. *coli* and eukaryotic RNA polymerases. ● Transcription process: Chromatin remodeling, Initiation, elongation and termination of RNA synthesis. ● Monocistronic and polycistronic RNAs ● Posttranscriptional modifications/processing of eukaryotic RNA: ● Capping and poly-adenylation, RNA splicing and splicing mechanisms. RNA editing ● Inhibitors of transcription	8
5	Translation and post translational modifications:	● General features of genetic code ● tRNA & aminoacyl tRNA synthetases, Ribosomes ● Translation process- Initiation, Elongation & termination of translation in prokaryotes and eukaryotes, Translational factors ● Inhibitors of protein synthesis – antibiotics and other inhibitors. ● Post-translational modifications: Covalent and enzymatic modification of proteins ● Protein folding, Proteolysis	8
6	Regulation of gene expression:	● Regulation of gene expression in prokaryotes: The operon model- lac, trp operons. Transcriptional control by attenuation in trp operon. ● Regulation of gene expression in eukaryotes ● Regulatory proteins (Transcription factors)- DNA-binding motif of regulatory proteins. Role of zinc fingers, leucine zippers, helix-turn-helix.	5

	Molecular evolution:	● DNA based phylogenetic trees and their applications.	1
Total Number of Lectures			**45**

METHODOLOGY

The course would be taught through lectures lectures supported by tutorials and assignments.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Turner. (1997). Instant notes in Molecular Biology. “Viva Publication.”
2. Freifelder, D., Jones and Bartlett. (2004). Microbial Genetics.
3. Freifelder, D., Jones and Bartlett. (2008). Molecular Biology.
4. Baker et.al. (2013). Molecular Biology of Gene Watson, 7th Edition. “Pearsons Publication.”
5. Alberts, B., Talor and Francis. (2008). Molecular Biology of the Cell.
6. Jones and Bartlett. (2010). Genes by Lewin and Benjamin. “Editions IX.”

PRACTICAL IN MOLECULAR BIOLOGY (4 HOURS PER WEEK) MARKS :100

Sr. No.	Name of the experiment	Learning objective	Literature/Weblinks for reference and videos
1	Preparation of glassware, plasticware, reagents and stocl solutions for molecular biolog	Special preparations for carrying out molecular biology experiments	Molecular cloning by J. Sambrook, F. Edward and T. Maniatis, 2nd edition, New York: Cold spring harbor laboratory press, 2012.
2	To isolate DNA from a) bacteria b) animal tissues/cells c) plant material using appropriate methods	To understand the critical requiremer specific methods depending on sourc DNA	
3	Quantification of DNA by UV absorption and analysis by aga gel electrophoresis	To understand the quality, and quanti DNA present per cell	
4	To isolate plasmid DNA from bacteria, restriction analysis ar agarose gel electrophoresis	To distinguish between plasmid and genomic DNA in terms of size and migration properties in gel	
5	To isolate RNA from eukaryo cells and analyse by denaturin formaldehyde agarose gel electrophoresis	To understand various types of RNA/RNA profile and quality of RN preparation	
6	To find the Melting temperatu DNA	Measure temperature and estimate T_m from your data	
7	Isolation of nuclei, calcium activation of endonuclease resulting DNA ladder includin mononucleosome formation	Hands-on verification of the concept chromatin structure	
8	Extraction of histone from nuc and analysis by SDS-PAGE	Understanding the contribution of histones in the formation of chromati	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 401.1	3	1	2	-	-	2	3	2	-	2	-	2	2	1	1
BT 401.2	3	3	3	-	-	2	-	-	2	1	-	3	2	1	1
BT 401.3	3	2	2	2	-	2	1	-	2	1	-	2	2	1	1
BT401.4	2	1	3	3	-	2	2	3	3	1	-	2	2	1	1
BT 401.5	3	2	3	3	3	2	2	2	1	1	3	2	3	2	2
BT 401.6	3	2	3	2	-	1	-	-	1	3	-	2	3	2	2

COURSE: ANIMAL TISSUE CULTURE

COURSE CODE: BT 406	**L T P Hr C**
MARKS: 100 (Theory 50 + Practical 50)	**2 0 2 4 3**

OBJECTIVE OF THE COURSE:

Complete understanding of the science of Animal Tissue Culture, with emphasis on Mammalian Cell Culture.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 406.1	Apply the knowledge of animal tissue culture to grow different types of cells and analyze the growth patterns and metabolic processes in cultured cells
BT 406.2	Distinguish between primary and secondary cell cultures and use appropriate techniques for establishing cell lines
BT 406.3	Design large-scale animal cell culture systems for the industrial production of therapeutic molecules
BT 406.4	Analyze the applications of in vitro and in vivo cell culture in various fields and develop 2D and 3D tissue models

PREREQUISITES:

Students should have undertaken a course in Cell Biology before taking this course on Animal Tissue Culture. Students should be aware of good laboratory practices.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction and essentials of animal tissue culture	History of animal tissue culture Sterilization methodologies Aseptic technique Laboratory set-up for ATC Equipment and materials used in ATC Terminology used in ATC. Safety & bioethics in ATC Types of tissue culture Culture media and components cell culture substrates Cell culture techniques/methods (Subculturing, Cell quantitation, , Cell separation, Cell transfection, special techniques) Contamination in cell culture Cryopreservation The art of animal cell culture;	6
	Growth, metabolism & biology of cultured cells	Energy metabolism Nutritional and physicochemical factors Growth parameters Cell adhesion and migration Cell proliferation, cell cycle, inhibition of growth Cell senescence, cell death Cell signaling, Growth factors Cell differentiation & dedifferentiation wrt Animal Tissue Culture	4
2	Primary cell culture	Establishment & maintenance of primary cell cultures: - General principles and methods Examples of adherent cell primary cultures including mammalian and insect cell cultures Examples of non-adherent primary cell cultures Characteristics of various specialized cell types	4

	Secondary cell culture	Establishment and maintenance of secondary and continuous cell cultures of mammalian cells Culture evolution Transformation and immortalization Cell cloning and selection	3
	Characterization of cell lines	Karyotyping & chromosome analyses Biochemical characterization Genetic characterization. Growth characteristics & tumorigenicity Protein markers	3
3	Large-scale animal cell culture	Large scale culture of adherent and suspension cells Bioreactors for large-scale culture Use of microcarriers Cell factories; automation	3
4	Applications of cell culture: *in vitro*	Hybridoma technology :Monoclonal Abs Production of therapeutic proteins & vaccines using cell culture *In vitro* cytotoxicity assays and tissue-engineered *in vitro* tissue models Cell migration assay, *In vitro* tumorigenicity, Cell invasion assay	4
		Types of cells for transplantation, culture of ESCs *In vitro* induction of cellular differentiation Three-dimensional cell culture & methods Tissue engineering/cell-based therapies Examples of commercialized cell-based products	3
Total Number of lectures			**30**

METHODOLOGY: The course will be taught through lectures, exercises, participative learning, videos.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 min	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1. Freshney, R. I. (2016). Culture of animal cells: A manual of basic technique and specialized applications (7th ed.). Wiley-Blackwell. Pastrnak, C. A. (Ed.). (2021). Basic cell culture protocols (4th ed.). Humana Press
2. Animal Cell Technology: From Biopharmaceuticals to Gene Therapy. L. R. Castilho et. al. Taylor & Francis Group, 2008.
3. Animal Biotechnology, by A. Akbarsha et. al., 1st edition, Pearson Education 2012.

PRACTICAL IN ANIMAL TISSUE CULTURE (2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference
1	Laboratory set-up and Equipment used in ATC	To understand the functions of ATC Laboratory and use of equipment in ATC	Culture of Animal Cells – A manual of basic technique and specialized applications by R. Ian Freshney, 6th edition, Wiley-Blackwell 2010 Development of 3D Alginate Encapsulation for Better Chondrogenic Differentiation Potential than the 2D Pellet System, T. Debnath et. al., J Stem Cell Res Ther 5:276. 2015 Apoptosis mediated cytotoxicity induced by isodeoxyelephantopin on nasopharyngeal carcinoma cells, A.K. Farha et. al., Asian J Pharm Clin Res, Vol 6, Suppl 2, 51-56, 2013.
2	Preparation of Ca^{++}-Mg^{++}-free phosphate buffered saline	The uses and method of preparation of PBS	
3	Preparation of cell culture medium	Composition and preparation of cell culture medium	
4	The practice of aseptic technique	Importance and practical knowledge of aseptic technique in ATC	
5	Subculturing of adherent cell line, with counting & viability staining of cells	Procedure, principle and nuances of passaging adherent cells, use of hemocytometer, Trypan Blue staining	
6	Cryopreservation and thawing of cells	Principle, procedure and critical steps in freezing and thawing cells	
7	Isolation of peripheral blood mononuclear cells	Method of density gradient centrifugation for PBMC isolation	
8	Isolation and culture of primary cells.	Technique and importance of primary cell culture	
9	Encapsulation of cells in alginate beads and MTT staining	Use and method for preparation of cell-laden alginate beads	
10	Cytotoxicity testing using cultured cells	Application of cultured cells for cytotoxicity testing	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BT406.1	3	3	3	-	-	3	3	1	3	3	-	3	3	3	1
BT 406.2	3	3	3	-	3	2	-	-	2	2	-	3	3	3	3
BT 406.3	3	3	3	3	3	3	3	2	**3**	3	3	3	3	3	3
BT 406.4	3	3	3	3	3	3	3	1	2	1	2	3	3	3	3

COURSE: BIOPROCESS ENGINEERING

COURSE CODE: MB 401	**L T P H C**
MARKS: 150 (Theory 50 + Practical 100)	2 **0 4 6 4**

OBJECTIVE:

The objective of the course is to create an understanding about basic industrial processes for the production of industrially and medically important compounds.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 401.1	Identify different types of bioreactors, explain the kinetics of cell growth and productivity
MB 401.2	Design a bioprocess facility and comprehend various control measures involved in bioreactors and fermentation processes
MB 401.3	Design and optimize ffermentation processes for medically important products
MB 401.4	Elucidate the procedures employed in downstream processing of biomedical products
MB 401.5	Discuss the large scale production of biological and biomedicinal compounds
MB 401.6	Design bioprocess engineering plan for a given medical application, considering cost, scale-up challenges, and specific requirements.

PRE-REQUISITES:

Students are expected to have a basic understanding in Biology.

COURSE DESCRIPTION:

Unit	Topics	Detail syllabus	No. of lectures
1	Fermentation Basics	● Design of a bioprocess facility ● Components of fermentation process ● Types of bioreactors with special emphasis on reactors for animal cell culture including single use bioreactors ● Kinetics of cell growth, productivity and yield	8
2	Measurement and control of bioprocess parameters	● PID systems ● Measurement and control of process variables- pH, temperature, pressure, flow, dissolved oxygen and carbondioxide	6
3	Process Optimization	● Design of experiments for fermentation process optimization ● Removal of adventitious agents in production of medically important products	4

Unit	Topics	Detail syllabus	No. of lectures
4	Downstream processing	● Centrifugation, Filtration, Precipitation ● Chromatography: basic and high-throughput bioseparations including affinity monolith chromatography	8
5	Large scale mammalian cell culture	● Case studies- production and downstream processing of a) Viral products (viral vaccines) b) Monoclonal antibodies c) Immunological regulators (interferons/ interleukins) d) Hormones (Follice stimulating hormone, erythropoietin) e) Enzymes (Hyaluronidase, tissue plasminogen activator) f) Other biosimilars/recombinant products (e.g., insulin)	8
6	Bioprocess engineering applications in medicine	● Tissue engineered skin replacements ● Chondrocyte culture for cartilage replacement ● Production of viral vectors for gene therapy ● Stem cell expansion and controlled differentiation	8
	Economics	● Scale up ● Challenges and cost economics	2
Total Number of Lectures			**44**

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.

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED

537976176 P. F. Stanbury, A. Whitaker and S. J. Hall. 'Principles of Fermentation Technology', Pergamon Press, Oxford and revised editions.1995.

537976624 J. E. Bailey, D. F. Ollis Biochemical Engineering Fundamentals, 2nd edition, McGraw-Hill, New. York) and revised editions. 1986

537976625 Pauline Doran, Bioprocess Engineering Principles, Academic Press (1995) and revised editions.

537976626 Shuler, ML and F. Kargi. Bioprocess. Engineering: Basic Concepts (Second Ed.). Prentice Hall, Englewood Cliffs, NJ. 2002.

PRACTICAL IN BIOPROCESSING ENGINEERING (4 HOURS PER WEEK) 100 MARKS

Sr. No.	Name of the experiment	Learning objective	Literature/ Web-links for reference and videos *
1.	Study of design of lab scale Stirred Tank Bioreactor (Lab scale fermenter) and calibration of different probes	To know basic of bioreactors with their parts and various dimensions. To understand the importance of calibration.	3
2	Measurement of control parameters during a fermentation- pH, temperature, dissolved oxygen	To know the importance of process parameters in bioreactors operations.	1,3
3	Removal of adventitious agents during fermentation of medically important products		
4	Production of streptomycin/penicillin antibiotic by fed batch fermentation and determination of antibiotic activity.	To learn upstream and downstream processing in antibiotic fermentation.	2,4
5	Recovery of medical compound/antibiotic from fermentation broth- precipitation, dialysis, concentration, chromatography	To understand different methods of DSP and their role.	4
6	Production of therapeutic recombinant products using fermentation	To learn culturing of recombinant cell.	1
7	Immobilization of yeast cells using different substrates and determination of biological activity	To know the basics of immobilization and its methods and significance.	3,4
8	Study of rheology of fermentation broth. Determination of viscosity, cell counts/ml, dry cell wt/ml broth and packed cell volume.	To know basic of fermentation process parameters and their significance.	1,3
9	Visit to Industry	To learn different units in industry such as production. Quality control, Quality assurance, R & D, and Lab. To study unit operations in industry.	

References:

1. Manual of Industrial Microbiology and Biotechnology (2nd Edition by Arnold L. Demain and Julian E. Davies, Ronald M. Atlas, Gerald Cohen, Charles L. Hershberger, Wei-Shou Hu, David H. Sherman, Richard C. Willson and J. H. David Wu)

2.Industrial Microbiology-An introduction (By Michael J. Waites, Neil L. Morgan, John S. Rockey and Gary Higton)

3.Principles of Fermentation Technology. (2nd edition, by Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Butterworth-Heinemann, An imprint of Elsevier Science

4.Fermentation and Enzyme Technology By D.I.C. Wang, C.L. Cooney, A.L. Demain, P. Dunnill, A.E. Humphrey & M.D. Lilly John Wiley and sons, New York

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 401.1	3	3	3	2	2	2	3	2	2	1	3	2	3	2	1
MB 401.2	2	3	3	3	2	3	3	1	2	2	3	3	3	2	1
MB 401.3	3	2	2	2	3	2	1	2	2	2	3	3	3	2	2
MB 401.4	3	2	3	2	3	2	3	2	1	1	3	2	3	2	2
MB 401.5	3	2	2	1	3	2	2	1	2	1	3	3	3	2	2
MB 401.6	3	3	3	2		3	2	2	2	1	3	2	3	2	3

COURSE: IMMUNOLOGY
COURSE CODE: BT 404 **L T P H C**
MARKS: 150 (Theory 100 + Practical 50)
3 0 2 5 4

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

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 404.1	Develop the basic understanding of immunology, mediators of immunity, and organs of the immune system
BT 404.2	Explain various components involved in humoral and cell mediated immune responses
BT 404.3	Explain the structure and functions of various immunoglobulins
BT 404.4	Apply various techniques for determining antigen-antibody interactions
BT 404.5	Outline the organization and inheritance of MHC and their role in antigen presentation
BT 404.6	Apply the basic and advanced knowledge of immunology in understanding health and diseases, and to develop treatment measures

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

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction to Immune System (i) The Cells and soluble mediators of the Immune system (ii) Organs of the Immune system	1. Historical Perspective: Early vaccination studi Early studies of Humoral and Cellular Immunity, Theoretical Challenges, Infection and Immunity (in brief) 2. The Cells and soluble mediators of the Immune system (i) Cells of the immune system : Phagocytes, B cells & T cells, Cytotoxic cells, and Auxillary cells (ii) Soluble mediators of immunity : Acute phase proteins, Complement proteins & Cytokines 3. Immune response to pathogens : Innate and Adaptive Immunity (i) Innate Immune response, Pathogen Associated Molecular Patterns (PAMPs), Phagocytes and Lymphocytes as a key mediators of Immunity (ii) Adaptive Immune Response : Features of the adaptive immune response: (Specificity and Memory) Humoral Immunity & Cell-mediated Immunity (Anti recognition and Antigen eradication, B cell clonal selection, Concept of antigen processing & presentati on MHC molecules) 4. Principle of vaccination 5. Inflammation: Principle components, Chemot 6. Consequences of Immune system failure : Autoimmunity, Immunodeficiency, & Hypersensitivit 1. Primary and Secondary lymphoid Organs 2. Primary lymphoid Organs (Thymus, Bone Marrow) 3. Secondary Lymphoid Organs (Lymph nodes, Spleen, and Mucosa associated Lymphoid tissue (MA	8
2	Generation of B cell & T cell response	1. Immunogenicity Versus Antigenicty 2. Haptens as valuable research and diagnostic to 3. Properties of Immunogen Contributing to Immunogenicity 4. Biological System contribution in Immunoger 5. Adjuvants : Freund's incomplete and complet adjuvant 6. Epitopes : Characteristic Properties of B-cell epitope	4
3	Immunoglobulins Structure	1. Basic structure of antibodies, Chemical and enzymatic methods for basic antibody structure	6

	and Function	2. Fine structure of antibodies 3. Antibody Classes and Biological activities 4. Antigen determinants on Immunoglobulins : Isotype, Allotype & Idiotype 5. Immunoglobulin Superfamily 6. Monoclonal Antibodies	
4	Antibody-mediated effector functions	1. Opsonization 2. Activation of complement system : Classical a alternative pathway 3. Antibody-dependent cell mediated cytotoxicit (ADCC)	3
	Organization and Expression of Immunoglobulin genes	1. Immunoglobulin genes organization & Rearrangements 2. Generation of antibody diversity 3. Synthesis, assembly, and Secretion of Immunoglobulins 4. Antibody Engineering	4
	Antigen-Antibody Interactions	1. Strength of antigen and antibody interactions: Antibody affinity, antibody avidity, and Cross reactiv 2. Precipitation reactions (Immunodiffusion and Immunoelectrophoretic technique) 3. Agglutination reaction 4. Radioimmunoassay 5. Enzyme linked Immunosorbant Assay (ELISA 6. Western blot 7. Immunoprecipitation 8. Flow Cytometry	6
5	The Major Histocompatibility Compl (MHC) and Antigen presentation	1. General Organization and Inheritance of the M MHC molecules 2. Peptide binding by class I and class II MHC molecules 3. Experimental demonstration to prove processi antigen is required for recognition by T cells 4. Antigen Presenting cells (APCs) 5. Antigen-Processing and Presentation Pathway (i) Endogenous Antigens: The Cytosolic Pathway (ii) Exogenous Antigens: The Endocytic Pathway	4
6	Immune system in Health and Diseas	1. Tolerance and Autoimmunity: Central and Peripheral Tolerance Establishment and Maintenance of Tolerance, Autoimmunity, Organ-Sp Autoimmune disease, Systemic Autoimmune Disease 2. Transplantation Immunology: Immunological basis of graft rejection, HLA typing, Mixed Lymphocyte Reaction, General Immunosuppressive Therapy 3. Immune Response to Infectious Diseases (Vir infections (Influenza virus) and bacterial infections (*Mycobacterium tuberculosis*), and Parasitic disease (*Plasmodium species*) 4. Vaccines: Active and Passive Immunization, I Attenuated vaccines, Inactivated or Killed Vaccines, Subunit and Conjugate Vaccines, DNA vaccines, Recombinant Vector Vaccines	6

		5. AIDS: HIV infection of target cells and Activa of Provirus, Stages in viral replication cycle for therapeutic anti-retroviral drugs, Therapeutic agents inhibiting retrovirus replication 6. Cancer and the immune system: Origin and terminology, Malignant transformation of cells, Oncogenes and Cancer induction, Tumors of the imm system, Tumor antigens, Tumor evasion of the immu system, Cancer immunotherapy	
Total Number of Lectures			**41**

METHODOLOGY:

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	60 minutes	20
II Internal	30 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS RECOMMENDED:

1. Immunology by J, Kuby , 5th edition, W.H. Freeman and company, New York, 2002.
2. Essentials of Immunology by I. M. Roitt, 10th edition, MOSBY, Elsevier Ltd. (International Edition), 2002.
3. Cellular and Molecular Immunology by A. Abbas, 8th edition, Elsevier Ltd., 2014.
4. Molecular Biology of the Cell by B. Alberts, 5th edition, Garland Science, 2007.

PRACTICAL IN IMMUNOLOGY(2 HOURS PER WEEK) MARKS 50

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1.	To determine Blood Group antigens by hemagglutination assay	To understand about the various blood group antigens present in a population; principle of agglutination	Immunology, The experimental Series – II by W. Luttmann, K. Bratke, M. Kupper, Myrtek, USA, Elsevier, Academic Press; 2006
2.	Detection of syphilis using RPR card test	Immunological detection of specific bacterial infections by indirect agglutination	Manual of clinical laboratory Immunology by N. R. Rose, R. G. Hamilton, B. Detrick, 6th edition, ASM Press, 2002. Practical immunology by F. C. Hay, M. R. Olwyn, 4th edition, Westwood. Blackwell Publishing Company; 2002. Immunology by J. A. Owen, J. Punt, S. A. Kuby, 7th edition, USA: Susan Winslow; 2013
3.	Detection of typhoid infection by WIDAL test	Immunological detection of specific bacterial infections by direct agglutination	Manual of clinical laboratory Immunology by N. R. Rose, R. G. Hamilton, B. Detrick, 6th edition, ASM Press, 2002. Immunology by J. A. Owen, J. Punt, S. A. Kuby, 7th edition, USA: Susan Winslow; 2013
4.	Density gradient separation of PBMCs using Histopaque-1077	Principle of density gradient separation of immune cells	Immunology by M. D, J. Brostoff, D. B. Roth, I. Roitt, 7th edition, Elsevier, 2007. Immunology, The experimental Series – II by W. Luttmann, K. Bratke, M. Kupper, Myrtek, USA, Elsevier, Academic Press; 2006 Cell Separation Media Methodology and Applications

			18111569, handbook GE Healthcare Isolation of mononuclear cells Methodology and Applications 18-1152-69, handbook GE Healthcare http://www.gelifesciences.com/handbooks/
5.	To study interaction of antigen and antibody by Ouchterlony double diffusion assay	To learn about precipitin phenomena at equimolar concentrations of antigen and antibody	● A handbook of practical and clinical immunology by G. P. Talwar, S. K. Gupta,. 2nd ed. Vol. I & II; 2006 ● Manual of clinical laboratory Immunology by N. R. Rose, R. G. Hamilton, B. Detrick, 6th edition, ASM Press, 2002. ● Practical immunology by F. C. Hay, M. R. Olwyn, 4th edition, Westwood. Blackwell Publishing Company; 2002. ● Immunology by M. D, J. Brostoff, D. B. Roth, I. Roitt, 7th edition, Elsevier, 2007.
6.	Determination of antibody titre by ELISA	To learn about different types of ELISA method and their applications	● A handbook of practical and clinical immunology by G. P. Talwar, S. K. Gupta,. 2nd ed. Vol. I & II; 2006 ● Manual of clinical laboratory Immunology by N. R. Rose, R. G. Hamilton, B. Detrick, 6th edition, ASM Press, 2002. ● Immunology by J. A. Owen, J. Punt, S. A. Kuby, 7th edition, USA: Susan Winslow; 2013.
7.	Production of polyclonal antibodies in mouse	Principle of immunization, collection and analysis of serum for antibody	A handbook of practical and clinical immunology by G. P. Talwar, S. K. Gupta,. 2nd ed. Vol. I & II; 2006
8.	Purification of IgG from serum	Single step purification of IgG by affinity chromatography	Physical Biochemistry, D. Freifelder, 2nd ed. W.H. Freeman and Company, New York; 1982 Affinity Chromatography, Vol. 1: Antibodies, 18103746, handbook GE Healthcare http://www.gelifesciences.com/handbooks/

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BT 404.1	3	3	2	-	-	2	-	-	2	3	-	3	2	1	-
BT 404.2	3	3	2	-	-	2	-	-	2	2	-	3	2	1	-
BT 404.3	3	2	2	-	-	2	-	-	2	3	-	3	2	1	-
BT 404.4	3	3	2	2	2	3	2	3	3	3	2	3	3	2	2
BT 404.5	3	2	2	1	-	1	-	-	2	2	-	2	2	1	-
BT 404.6	3	2	2	1	1	2	3	3	3	3	2	3	2	1	-

COURSE: DEVELOPMENTAL BIOLOGY
COURSE CODE: BT 405 **L T P Hr C**
MARKS: 150 (Theory 100 + Practical 50) **3 0 2 5 4**

OBJECTIVE OF THE COURSE:
The objective of the course is to develop a basic understanding of animal development, emphasizing on various stages in embryonic development. The course would also give an insight on the influences of environment in animal development and applications of basic research in developmental biology.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BT 405.1	Elucidate the morphological operations that convert a fertilized egg into a multicellular organism
BT 405.2	Describe the molecular, biochemical, and cellular processes that control the formation of specialized cells, tissues, and organs during embryonic development
BT 405.3	Recognize the model organisms utilized in the study of developmental biology and contrast the developmental schemes of various organisms
BT 405.4	Explain the genetic, molecular, and cellular methods, inclusive of genome editing, employed to study the processes of development in different organisms
BT 405.5	Showcase the ability to observe and use technical skills to obtain and examine quantitative data, interpret results, and present experimental data
BT 405.6	Discuss the importance of developmental biology in reproduction including assisted reproductive technologies

PREREQUISITES:
The course requires senior school (10+2 or equivalent) level knowledge of development in animals.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1.	Introduction to Developmental Biology	● Early beliefs in organismal development ● Discovery of primary embryonic organizer	2
2.	Gametogenesis and Fertilization	● Spermatogenesis and Oogenesis in placental mammals (mouse/human) ● Comparison of internal and external fertilization ● Steps in the fertilization process in mouse/human: Capacitation of sperm, Acrosome Reaction, Sperm-egg fusion, Activation of the egg, Fusion of sperm and egg pro-nuclei, Prevention of polyspermy (with reference to placental mammals and sea urchin)	6

	Embryonic Cleavage	● Cytoskeletal mechanisms in cleavage ● Maternal-zygotic transition ● Types of cleavage based on potentiality of blastomeres, position and amount of yolk, and position of mitotic spindles ● Emphasis on cleavage in embryos of echinoderms (sea urchin), molluscs (snail), amphibians (frog) and placental mammals (mouse/human)	5
.	Stages after embryonic cleavage and Gastrulation	● Pre-implantation and implantation of mouse/human embryos ● Primary germ layers and their derivatives in placental mammals ● Various types of morphogenetic movements during gastrulation ● Gastrulation in mouse/human embryos with emphasis on primitive streak, differentiation of lateral mesoderm and somitogenesis	5
3.	Genes and Development	● Origin of gene theories in development ● Genomic equivalence: Evidences with emphasis on metaplasia and animal cloning, and exceptions to the rule ● Differential gene expression: Regulation at the level of genome, transcription, translation and post-translation ● Gene silencing: Antisense RNA and Gene knockouts ● Cell fate specification based on position and lineage in early embryogenesis ● Lateral inhibition in *Drosophila* neurogenesis	7
	Axes formation and Organogenesis	● Axes formation and early embryonic patterning in *Drosophila* and vertebrates ● Homeotic genes ● Development of the germ layer derivatives with emphasis on the formation of central nervous system and epidermis, fore-limb and hind-limb in vertebrates	6
4.	Metamorphosis and Regeneration	● Complete and incomplete metamorphosis, metamorphosis in insects and Anurans ● Epimorphosis, Morphallaxis and Compensatory regeneration	4
5.	Environmental influences in development	● Environmental disruption of normal development ● Teratogens, with emphasis on alcohol, retinoic acid and pathogens ● Endocrine disruptors	4
6.	Translational developmental biology	● Biology of stem cells ● Applications of stem cells in regenerative medicine ● Assisted reproductive technology on *in vitro* fertilization (IVF) and intra-cytoplasmic sperm injection (ICSI) ● Genetically modified organisms (GMOs) and their applications in biomedical research	4
Total Number of lectures			**44**

METHODOLOGY:

The course would be covered through lectures and group discussions using teaching aids.

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
I Internal	60 minutes	20
II Internal	45 minutes	15
Attendance		5
End Semester Exam	2 hours 30 minutes	60
Total		**100**

BOOKS/JOURNALS RECOMMENDED:

1.

1. Gilbert, S. F., Barresi, M. J. F. (2016). Developmental Biology, Eleventh Edition, Sinauer Associates Inc.

2.Wolpert, L., Tickle, C., Arias A. M. (2015). Principles of Development, Fifth Edition, Oxford University.

3.Slack, J. M. W. (2012). Essential Developmental Biology, Third Edition, Wiley- Blackwell.

4. S. Sell (Ed.) (2013). Stem Cells Handbook, Second Edition, Humana Press, New York, USA.

2. Genes and Development, Cold Spring Harbor, New York, USA, Years: 1987–present.

3. Development, The Company of Biologists, United Kingdom, Years: 1953–present, **Journal ISSN**: 0950-1991 (print); 1477-9129 (web), (Former name: Journal of Embryology and Experimental Morphology).

4. Developmental Biology, Elsevier B.V., Amsterdam, Netherlands, Years: 1959–present, **Journal ISSN**: 0012-1606 (print); 1095-564X (web).

PRACTICAL IN DEVELOPMENTAL BIOLOGY (2 HOURS PER WEEK) MARKS: 50

Sr. No.	Name of the Experiment	Learning objective	Literature/ Weblinks for reference and videos
1.	Introduction to life cycle in animal development (eg: *Drosophila*).	Familiarization with various stages of life cycle in insects. Understanding the the phenomenon of metamorphosis, and differentiation of the sexes.	Fly Pushing: The theory and practice of *Drosophila* genetics, By R. J. Greenspan 2nd Edition The Neurosciences Institute, San Diego.
2.	Dissection and identification of imaginal discs in the third instar larval stages in *Drosophila*.	Familiarization with the location and types of the progenitors of various adult structures.	1) Dissection of imaginal discs from 3rd instar *Drosophila* Larvae, D. C. Purves and C. Brachmann. *J Vis Exp*; (2): 140. 2007. 2) The preparative isolation of imaginal discs from larvae of *Drosophila Melanogaster*, J. W. Fristrom and H. K. Mitchell, *J Cell Biol*; 27: 445–448, 1965. 3) Fly Pushing: The theory and practice of *Drosophila* genetics, By R. J. Greenspan 2nd Edition The Neurosciences Institute, San Diego.
3.	Preparation and mounting of *adult Drosophila structures* in Hoyer's medium or Canada balsam.	Familiarization with wings, legs and thorax in adult flies and understanding the patterning of these cuticular structures.	1) Preparation and mounting of adult *Drosophila* structures in Canada balsam, D. L. Stern and E. Sucena, *Cold Spring Harb Protoc*; 373-375, 2012. 2) Preparation and mounting of adult *Drosophila* structures in Hoyer's medium, D. L. Stern and E. Sucena, *Cold Spring Harb Protoc*, 107-109, 2012.
4.	Examination of external morphology of *Drosophila* eyes using nail polish imprint technique.	Understanding the patterning of compound eye in insects.	A simple nail polish imprint technique for examination of external morphology of *Drosophila* eyes, R. Arya and S. C. Lakhotia, *Curr Sci*; 90:1179-1180, 2006.

Sr. No.	Name of the Experiment	Learning objective	Literature/ Weblinks for reference and videos
5.	Preparation and identification of 48 hours and 96 hours chick whole-embryos using filter paper ring technique.	Familiarize with prominent structures formed during organogenesis in early chick embryos.	Improved method for chick whole-embryo culture using a filter paper carrier, S. C. Chapman et al, *Dev Dyn*; 220:284-289, 2001.
6.	Study of cell death during morphogenesis	Observation of cell death in chick embryos (5 days old) limd morphogenesis	
7.	Staining bone and cartilage in zebrafish (*Danio rerio*) embryos.	To study skeletogenesis using a unique model that is amenable to developmental analyses and genetic screening.	1) A two-color acid-free cartilage and bone stain for zebrafish larvae, M. B. Walker and C. B. Kimmel, *Biotechnic & Histochemistry*, 82: 23-28, 2006. 2) Zebrafish embryology and cartilage staining protocols for high school students, Emran F et al, *Zebrafish*; 6: 139-143, 2009.
8.	Study of regeneration in Hydra	Observation of regeneration process in Hydra	

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 405.1	1	2	1	-	-	1	-	1	1	1	-	2	2	1	-
BT 405.2	1	2	1	2	2	1	-	1	1	1	-	2	2	1	-
BT 405.3	1	1	1	1	1	1	1	1	1	1	1	3	2	1	1
BT 405.4	2	2	1	3	2	1	1	1	1	1	1	3	3	2	2
BT 405.5	2	3	1	3	2	1	1	1	1	1	1	2	3	2	2
BT 405.1	1	2	1	-	-	1	-	1	1	1	-	2	2	1	-

COURSE: PHARMACOLOGY & TOXICOLOGY
COURSE CODE: MB 402 **L T P Hr C**
MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVE:

The objective of the course is to familiarize the students with aspects of Pharmacology, principles of Drug Action and toxicology.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 402.1	Comprehend the important aspects of drug discovery and development process through clinical trials
MB 402.2	Explain the chemical kinetics and mechanism of action of drugs; discuss the current and future aspect of pharmacology
MB 402.3	Describe toxins and toxicants with their physiological dose response and intercellular chemical communication.
MB 402.4	Discuss xenobiotic metabolism and explain chemical interactions involved in toxicity

PREREQUISITES

Since the course is very basic in scientific world, student must know about relationship between drugs with biological cell.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Pharmacology Introduction	History and scope Definitions and terms. Organized drug discovery and development.	2
	Clinical Developments	Pre-clinical development: Clinical trials, patenting procedure	2
2	Mechanism of action	Molecular principles in agonist and antagonist action. Drug receptor interaction: Ligand-gated ion channel, G-protein coupled receptors, Kinase and enzyme linked and nuclear receptors.	4

	Chemical Kinetics	Principles and practice of transition state mimicry Illustrative examples, collected substrate analogue inhibitors ,and design strategies	4
3	Aspects of Pharmacology	Combinatorial approach to compound libraries, current status and future Prospects.	2
	Toxicology Introduction	Definition of toxins and toxicants, Sister sciences, Toxicokinetics: Absorption, Distribution, Biotransformation, Excretion. Endocrine Disruptors	3
	Dose Response	Physiologic dose-response, Dose–Response Assessment: NOAEL The role of intercellular chemical communication.	4
4	Metabolism of Xenobiotics	Biochemistry of Xenobiotics metabolism, Phase I and Phase II enzymes and reactions,	3
	Interaction of chemicals	Developmental status/age and toxicity Chemical Carcinogenesis Human Health Risk Assessment	3
	Experimental Toxicity Testing	*In vivo* and *in vitro* tests Acute, sub-chronic, chronic, Mutagenicity and carcinogenicity Special Tests	3
Total Number of lectures			**30**

METHODOLOGY

The course would be taught through lectures, demonstrations.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 min	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

1 Comprehensive medicinal chemistry-VolI & VolVI by C. Hansch.
2 Design of enzyme inhibitors as drug by M.sandle & H. J. Smith
3 Computer aided drug design by T.J.Pexin & C.L. Propst Dekk14e.
4 Klaassen. McGraw-Hill:New York, NY. 2001. 1236 pp.
5 Casarett & Doull's Toxicology: The Basic Science of Poisons, 6th Ed.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 402.1	2	2	3	3	-	2	-	-	2	3	-	3	2	1	1
MB 402.2	2	3	3	2	3	3	-	-	2	2	-	3	2	1	-
MB 402.3	3	2	2	3	3	2	-	-	2	3	-	2	2	1	-
MB 402.4	2	3	3	2	3	2	2	1	2	2	-	2	2	2	1

COURSE: INDIAN KNOWLEDGE SYSTEM: INDIAN REGIONAL BIODIVERSITY

COURSE CODE: BTIKS401 **L T P Hr C**

MARKS: 50 **0 1 0 1 1**

OBJECTIVE:

The objective of this course is to make students aware and familiarize them with the Indian Knowledge System to create a holistic and culturally sensitive learning environment. By incorporating elements of IKS into modern education, students can gain a deeper understanding of their cultural heritage, diverse perspectives, and alternative ways of knowing.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTIKS401.1	Understand a holistic understanding of India's traditional knowledge systems and their relationship with regional biodiversity
BTIKS401.2	Explore various biogeographical zones and their characteristics
BTIKS401.3	Analysis of India's various ecosystems, that include tropical rainforests, deserts, marshes, and mountain ranges, regional biodiversity influencing ecosystem processes and services.
BTIKS401.4	Assess the present conservation problems facing Indian regional biodiversity and evaluate viable methods and policies for the protection and sustainable management of these natural resources.

PREREQUISITES:

Open to new ideas and willingness to learn and contribute.

COURSE DESCRIPTION

Sr. No.	Topic	Detailed syllabus	No. of Lectures
1.	**Introduction to Indian Knowledge System (IKS),**	• Overview of India's traditional knowledge systems (e.g., Ayurveda, Yoga, Vastu Shastra, etc.). • Understanding the integration of traditional knowledge with nature and biodiversity. • Role of traditional ecological knowledge in resource management.	**1**
2	**Biogeographic Zones of India**	Overview of India's biogeographic zones and their characteristics.	**3**

		• Study of the Himalayan region, Indo-Gangetic Plains, Western Ghats, Eastern Ghats, Deccan Plateau, and coastal areas.	
2.	***Biodiversity of the Western Ghats, Coastal areas and marine ecosystems***	● Exploration of the Western Ghats biodiversity hotspot. ● Tropical rainforests and endemic species. ● Threats and conservation challenges. ● Traditional ecological insights and conservation practices. ● Coastal areas, mangroves, estuaries, and marine biodiversity. ● Traditional knowledge related to coastal resource management. ● Conservation policies and practices integrating traditional wisdom.	**4**
3.	**Biodiversity of the Indo-Gangetic Plains, Forests, Desert ecosystems**	● Flora and fauna of the Indo-Gangetic region. ● Riverine ecosystems and their ecological importance ● Tropical and sub-tropical evergreen and deciduous forests. ● Protected areas and wildlife reserves. ● Thar Desert ecosystems and adaptations	**4**
4.	***Conservation Strategies***	● Habitat destruction and fragmentation ● Pollution and its impact on biodiversity. ● Climate change and its implications for Indian biodiversity. ● Integration of traditional ecological knowledge with modern conservation strategies. ● Collaborative conservation efforts with local communities. ● Ethical considerations and issues related to biodiversity research and conservation.	**4**
		Total Number of Lectures	**16**

METHODOLOGY

The course will be covered through lectures & assignments.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Recommended Reading:

1. Introduction to Indian knowledge system: concepts and applications. ISBN: 9789391818203, authors: B. Mahadevan, Nagendra Pavana , Vinayak Rajat Bhat.
2. Living with others (Biodiversity around us). ISBN: 9788123017464. author: M.A. Haque
3. 3) Biodiversity and livelihood: lessons from community research in India. ISBN: 978-981-14-8307-3, authors: Oommen V., Oommen, Laladhas K, Erach Bharucha
4. 4) Biodiversity traditional knowledge and intellectual property rights, ISBN: 9788172339692, authors: s. Ram Reddy, M. Surekha, V. Krishna Reddy
1) Biodiversity hotspot of the western ghats and Sri Lanka. ISBN:9781774913758, author: T. Pullaiah
2) Ethnobotany of India, volume 2: western ghats and west coast of peninsular India, ISBN: 978-1771884044, authors: T. Pullaiah, K. V. Krishnamurth, Bir Bahadur
3) SAHYADRI : WESTERN GHATS BIODIVERSITY INFORMATION SYSTEM (http://ces.iisc.ernet.in/biodiversitsy)

Matrix for Program Outcome and Program Specific Outcome

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
BTIKS401.1	-	-	-	-	-	-	2	-	1	-	-	-	-	1	-
BTIKS401.2	-	1	-	-	-	1	2	-	1	-	-	1	-	1	-
BTIKS401.3	1	1	1	-	1	1	2	-	1	-	-	-	-	-	-
BTIKS401.4	1	1	1	-	1	1	2	1	1	-	-	1	1	1	-

COURSE: APTITUDE BUILDING-IV

COURSE CODE: BTAEC401 **L T P Hr C**

MARKS: 50 (Practical only) **0 0 2 2 1**

OBJECTIVES:

1. To enhance the logical reasoning skills of the students and help them improve the problem-solving abilities
2. To acquire skills required to solve quantitative aptitude problems
3. To boost the verbal ability of the students for academic and professional purposes

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC401.1	Apply critical thinking skills, such as problem solving related to their subject matter
BTAEC401.2	Demonstrate competency in verbal, quantitative and reasoning aptitude
BTAEC401.3	Display good written skills for use in academic and professional scenarios
BTAEC401.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact Hours
1	Logical Reasoning	04
2	Data interpretation and Data sufficiency - Advanced	04
3	Time and work– Advanced	02
4	Time, Speed and Distance - Advanced	04
5	Profit and loss, Partnerships and averages - Advanced	02
6	Number system - Advanced	02
7	Choice and Instruments and protocols for solving biological problems	02
8	Establishment of stable trans-gene expression in unicellular and multicellular systems	02
9	Monoclonal antibodies, Biosimilars	02
10	Competitive Examination Preparation	02
11	Mock Interviews	02

12	Discussion session-Industry Experts/Academia Experts/Alumni	02
	Total Number of Practical/Training Hours	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Continuous Internal Assessment		20
Attendance		
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

BOOKS RECOMMENDED:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing

2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.

3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BTAEC401.1	-	2	2	1	2	-	-	-	-	1	-	2	2	-	-
BTAEC401.2	1	1	1	-	-	-	-	-	-	1	-	-	1	-	-
BTAEC401.3	1	1	1	-	2	-	-	-	-	2	-	-	1	-	-
BTAEC401.4	1	1	1	-	1	-	-	-	-	1	-	-	1	-	-

SEMESTER V						
MB 501	Biopharmaceuticals	2	0	2	4	3
MB 502	Genetic engineering	3	0	4	7	5
MB 503	Tissue Engineering and Transplantation	2	0	2	4	3
BI 501	R Programming	1	0	0	1	1
BI 502	Molecular modelling and drug designing	2	0	4	6	4
MB 504	Disease Biology	2	0	0	2	2
MB 505/506	Elective 1	2	0	0	2	2
BTSEC501 (Skill Enhancement Course)	Science communication (research paper presentation and critical review, scientific proposal, journal club, science media)	0	0	2	2	1
BTAEC501 (Ability Enhancement)	Aptitude Building-V (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
	Total	**14**	**0**	**16**	**30**	**22**
Elective I: (Cancer Biology / Nanomedicine)						

COURSE: BIOPHARMACEUTICALS

COURSE CODE: MB 501 **L T P Hr C**

MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVE:

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.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 501.1	Discuss the current status of biopharmaceuticals in the pharmaceutical industry
MB 501.2	Acquire the knowledge of good manufacturing practices and recognise their importance in formulation of biopharmaceutical products
MB 501.3	Evaluate the advantages and disadvantages in the production of therapeutically important hormones, growth factors, blood products and, enzymes
MB 501.4	Apply the knowledge of gene therapy, vaccine and antisense technology in biopharmaceutical production

Prerequisites: Students should know the basics of Microbiology, Biochemistry.

Unit	Topics	Detailed syllabus	No. of Lectures
1	Overview	Introduction and current status of Biopharmaceuticals in the pharmaceutical industry. How are Biopharmaceuticals different from Pharmaceutical products	02
2	The drug manufacturing process	Good Manufacturing Practices: Cleanroom, cleaning, documentation and sanitation (CDS), preparation of purified water and water for injection for the biopharmaceutical processing, Source of Biopharmaceuticals: *E.coli* as a source of recombinant, transgenic animals, and transgenic plants Analysis of final biopharmaceutical products: Detection of protein based product impurities, pyrogen detection, endotoxin assay, and immunological approaches	07
3	Hormones of therapeutically interest	Insulin, Insulin receptors, production of human insulin by rDNA technology, insulin formulation, and Glucagon	05

	Blood products and therapeutic enzymes	Anticoagulants: Hirudin, Vitamin K, and Antimetabolites, Oxygen carrying blood substitutes: Albumin, Dextran, and Gelatin	04
	Growth factors and wound healing	Insulin growth factor (IGF), Epidermal growth factor (EGF), and Platelet derived growth factor (PDGF), Wound healing process	05
4	Vaccines and Nucleic acids therapeutics	Vaccines: Types of vaccines, peptide vaccine, and vaccine vectors Basic approach to gene therapy: Types of gene therapy vectors Antisense technology: Uses, advantages, and limitations	07
Total Number of Lectures			**30**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 min	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED:

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

PRACTICALS IN BIOPHARMACEUTICALS (2 HOURS PER WEEK) 50 MARKS

Sr. No.	Name of the experiment	Learning objective	Literature/ Weblinks for reference and videos
1	Chemical assay for estimation of penicillin /streptomycin/tetracycline Antibiotics	To know the simple assay for antibiotic determination. To understand chemical composition and reactivity. To know the mode of action of antibiotics	1. Kayser O, Warzecha H. Pharmaceutical biotechnology: drug discovery and clinical applications. John Wiley & Sons; 2012. 2. Beale JM, Block J, Hill R. Organic medicinal and pharmaceutical chemistry. Philadelphia: Lippincott Williams & Wilkins; 2010. 3. Foye WO. Foye's Principles of Medicinal Chemistry. Lemke TL, Williams DA, editors. Lippincott Williams & Wilkins; 2008 4. Lachman, Leon et al. "The Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1986. 5. Godkar PB, Godkar DP, Textbook of Medical Laboratory Technology Bhalani Publishing House, 2014 by
2	Bioassay to determine the antifungal activity of standard Aureofungin/ clotrimazole/ fluconazole/	To know the simple assay for determination of antifungal compounds. To know the mode of action of antifungal compounds. To understand the structure of antibiotic	
3	Bioassay to determine the antibacterial activity of standard penicillin, streptomycin, tetracycline antibiotics by standard disc/well method	To know the role of bioassay in pharmaceuticals. To understand the disc and well diffusion assay Method	
4	Sterility testing of commercial injectable such as saline water, eye drops or ear drops	To determine the quality of pharma products with respect to microbial contamination. To understand the commercial significance of sterility testing in biopharmaceutical Products	

5	Extraction and detection of antimicrobial compounds from plant origin	To understand different method of extraction. To know antimicrobial compounds from plant origin. To know the diffusion of antibiotic and factors affecting it	6. Husain A, Practical Pharmaceutical Analytical Techniques, Darshan Publishers, 2015 7. Indian Pharmacopeia, 2007, Volume 1, Published by The Indian Pharmacopeia Commission, Ghaziabad; Tests for pyrogens
6	Determination of glucose in serum/plasma by GOD/POD method	To estimate the concentration of glucose in samples. The correlation of glucose concentration with different clinical conditions	
7	Determination of endotoxin in the therapeutic formulation (WFI, gentamycin injection ampicillin injections) by using LAL test reagent	To know endotoxin of bacterial origin, its structure and their role. To learn Significance of LAL test at commercial Level	
8	Determination of SGPT/SGOT activity in serum / plasma sample by chemical method	To estimate the concentration of SGOT and SGPT in samples. To learn importance of SGPT and SGOT activity with functional test The correlation of glucose concentration with different clinical conditions	
9	LIMIT test for chloride, sulphates, iron and heavy metals in pharmaceutical products.	To learn threshold level of ions in the pharmaceutical products. To understand the significance of LIMIT test at commercial level	
10	One day industrial visit to a pharmaceutical company	To understand the commercial production of biopharmaceutical Products	

Sr. No.	Name of the experiment
1	Chemical assay for estimation of penicillin /streptomycin/tetracycline Antibiotics
2	Bioassay to determine the antifungal activity of standard Aureofungin/ clotrimazole/fluconazole
3	Bioassay to determine the antibacterial activity of standard penicillin, streptomycin, tetracycline antibiotics by standard disc/well method
4	Sterility testing of commercial injectable such as saline water, eye drops or ear drops
5	Extraction and detection of antimicrobial compounds from plant origin
6	Determination of glucose in serum/plasma by GOD/POD method
7	Determination of endotoxin in the therapeutic formulation (WFI, gentamycin injection ampicillin injections) by using LAL test reagent
8	Determination of SGPT/SGOT activity in serum / plasma sample by chemical method
9	LIMIT test for chloride, sulphates, iron and heavy metals in pharmaceutical products.
10	One day industrial visit to a pharmaceutical company

PRACTICAL EVALUATION SCHEME

Examination	Marks
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 501.1	1	2	2	-	-	-	-	-	3	3	-	3	2	2	2
MB 501.2	2	2	3	3	2	3	3	2	2	2	1	2	1	2	2
MB 501.3	3	3	2	2	3	3	2	2	1	1	2	2	2	2	1
MB 501.4	2	3	3	2	3	2	2	2	2	2	2	2	2	2	1

COURSE: GENETIC ENGINEERING

COURSE CODE: MB-502 **L T P H C**
MARKS: 200 (Theory 100 + Practical 100) **3 0 4 7 5**

OBJECTIVE:

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

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 502.1	Apply the knowledge of molecular biology to conceptualize genetic engineering and analyze the advantages of using microorganisms in genetic engineering for the production of new pharmaceuticals
MB 502.2	Summarize the tools in involved genetic engineering and demonstrate different recombinant DNA techniques ascertaining manipulation of DNA, RNA and protein
MB 502.3	Illustrate different gene cloning strategizes to create genomic libraries to screen recombinant biomolecules
MB 502.4	Plan and employ different recombinant DNA techniques in healthcare and agricultural sector
MB 502.5	Apply genetic engineering techniques in diagnosis of human disorders and strategizing suitable therapies
MB 502.6	Outline the objective of human genome project and give insights on personalized medicine

Prerequisites: Knowledge of molecular biology is sufficient

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction	Landmarks in Molecular Biology and Biotechnology What is genetic engineering and recombinant DNA technology? Advantages of using microorganisms in Genetic Engineering Genetic engineering in *E. coli* and other prokaryotes, yeast, fungi and mammalian cells.	3
2	Tools in genetic engineering	Enzymes: DNA polymerases, ligases, reverse transcriptases, nucleases restriction endonucleases (Restriction modification system, Restriction	

		mapping) and, terminal transferases, phosphatases, polynucleotide Kinase etc. Cloning vectors: plasmids, bacteriophage vectors, cosmids, phagemids BAC,YAC vectors, Shuttle vectors, expression vectors etc.	7
	Recombinant DNA techniques	Polymerase chain reaction (PCR) and its types Molecular Probes and Nucleic acid labeling Blotting Techniques (Northern, Southern and Western) Autoradiography, Hybridization, DNA foot printing, Electrophoretic mobility gel shift assay (EMSA) DNA sequencing, site directed mutagenesis and its applications DNA fingerprinting techniques, RAPD, RFLP, AFLP. Different methods for analysis of gene expression	8
3	Gene cloning	Isolation and purification of DNA (genomic, plasmid) and RNA. Isolation of gene of interest- restriction digestion, electrophoresis, Cutting and joining of DNA Methods of gene transfer in prokaryotic and eukaryotic cells. Methods for Recombinant selection and screening: genetic, immunochemical, South-western analysis, nucleic acid hybridization, HART, HRT Expression of cloned DNA molecules and maximization of gene expression Cloning strategies- genomic DNA libraries, cDNA libraries, subtractive hybridization,	10
4	Applications of Recombinant DNA technology	In Medicine, in generation of disease resistant animals, Gene therapy: In vivo approach, ex-vivo approach of gene therapy, Antisense therapy, Interference technology (siRNA, shRNA, miRNA), CRISPAR Cas 9 mediated gene therapy, Transgenics animals	8
5	Genetic disorders, Diagnosis and screen	Prenatal diagnosis, Single nucleotide polymorphisms, DNA microarrays, Future strategies.	4
	Protein interaction technology	Two-hybrid and other two component systems Detection using GST fusion protein, co-immunoprecipitation, FRET, BRET, Phage display assays, Surface plasmon resonance (SPR) etc	3
6	The Human Genome Project	The Human Genome Project: Objectives and its outcome, Brief concept of personalized medicine.	2
Total Number of Lectures			**45**

METHODOLOGY

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

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Internal Exam I	60 min.	20
Internal Exam II	45 min.	15
Attendance		05
End Semester Examination	2 Hrs 30 min.	60
Total		**100**

PRACTICAL: RECOMBINANT DNA TECHNOLOGY (4 HOURS PER WEEK) 100 MARKS

List of practicals

1. Requirement of a genetic engineering lab including physical containment facilities and other biosafety procedures
2. Culturing Escherichia coli K12 and making competent cells for transformation
3. Preparation of the vector DNA and target DNA, ligation and transformation
4. Elution of DNA from Agarose gel
5. Selection of transformants by

I. Antibiotic resistance
II. Blue-white screening
III. Restriction analysis

6. Preservation and storage of clones
7. Cloning in expression vectors for expression of specific genes
8. Target DNA amplification by polymerase chain reaction
9. DNA finger printing technique RFLP/RAPD
10. Bioinformatics tools in Genetic engineering

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

REFERENCES:

1. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard Twyman, eighth edition, John Wiley and Sons Ltd, June 2016

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 502.1	3	1	1	1	3	1	1	1	1	1	1	3	3	2	1
MB 502.2	3	3	3	3	3	1	2	2	2	3	1	3	1	3	1
MB 502.3	3	3	3	3	3	2	2	2	3	2	2	3	3	1	1
MB 502.4	3	3	3	3	3	3	3	3	3	2	2	3	3	1	1
MB 502.5	3	3	3	3	3	3	2	3	3	2	3	3	3	1	1
MB 502.6	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

NAME OF THE COURSE: TISSUE ENGINEERING AND TRANSPLANTATION

COURSE CODE: MB 503 **L T P H C**

MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVE:

- To impart training and competence in the modern science of Tissue Engineering and Regenerative Medicine
- To enable the student to design the tissue engineering substitute for regeneration of defected tissue.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 503.1	Recognize different types of tissues and cells for tissue engineering, and explain tissues mechanical properties and concept of cellular reprogramming
MB 503.2	Discuss different types and sources of biomaterials and their utility in scaffold fabrication
MB 503.3	Explain various methodologies for tissue engineering and construct 3D cell culture methods
MB 503.4	Use various technologies for tissue engineering and develop insights into clinical translation of engineered tissue considering the regulatory and ethical norms

PREREQUISITES

Students should have undertaken courses in Cell Biology and Animal Tissue Culture.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of lectures
1	Introduction and background of tissue engineering	History of Tissue Engineering Elements of Tissue Engineering Degenerative Diseases Organ transplantation	03
	Concepts in tissues and cells	Types of tissues Cells and environment, Cell differentiation, Epigenetics Early embryonic development Mechanical properties of cells and tissues	03

	Cells for tissue engineering	Different types of cells for tissue engineering with advantages and disadvantages; adult stem cells, embryonic stem cells, perinatal stem cells, induced pluripotent stem cells, mesenchymal stem cells, differentiated cells. Cellular reprogramming Autologous/allogeneic cells, Cells and immunogenicity,	06
2	Biomaterials in tissue engineering	Types of biomaterials (metals, ceramics, polymers, natural/synthetic), extracellular matrix as a biomaterial; Roles of biomaterials in tissue engineering Biocompatibility, biodegradability Types of biomaterial scaffolds; classical methods of scaffold fabrication; electrospinning Rapid prototyping, organ decellularization;	06
3	Methodologies for tissue engineering	Three-dimensional cell culture methods, Self-organization, cell sheet engineering, scaffold-based methods; microfabrication Cell and organ printing, extrusion printing, laser-assisted printing, inkjet-type printing Vascularization of engineered tissues Bioreactors for tissue engineering	07
4	Technologies relevant in tissue engineering	Gene therapy, protein therapy Nanotechnology Controlled release, microfluidics, cell encapsulation, smart materials	03
	Tissue engineering in practice	Clinical translation of cell therapies and tissue-engineered products; Ethical issues in regenerative medicine	02
Total Number of Lectures			30

METHODOLOGY

The course will be taught through lectures, exercises, participative learning, videos and and supported by Practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 mins	15
Attendance	----	5
End Semester Exam	1 hour 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

PRACTICAL IN TISSUE ENGINEERING AND TRANSPLANTATION

(2 HOURS PER WEEK) **MARKS: 50**

Sr. No.	Name of the experiment
1	Preparation of ear-shaped hydrogel scaffolds.
2	Preparation of porous scaffolds
3	Culture of cells in porous scaffold and histological analysis
4	Preparation of tubular conduits used for blood vessel engineering
5	Preparation of constructs with vascular-like channel
6	Encapsulation of cells in alginate beads and MTT staining

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 503.1	3	2	2	2	1	2	3	3	1	3	2	1	2	2	1
MB 503.2	3	2	2	3	2	3	2	2	-	2	2	2	2	2	1
MB 503.3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	2
MB 503.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

COURSE: R Programming
COURSE CODE: BI 501 **L T P Hr C**
MARKS: 50 (Theory only) **1 0 0 1 1**

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
BI 501.1	Apply the essential concepts of R programming
BI 501.2	Use various data structures for writing programs
BI 501.3	Apply data and file handling features in writing a program
BI 501.4	Implement statistical packages in R programming for analyses of biological data

PREREQUISITE:

- In depth knowledge of C programming is required
- Basic understanding of Statistics & Data Structure
- Basic knowledge of Molecular Biology, Genetics, Biochemistry and Computer aided drug designing.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction and basics of R	What is R? History of R Features of R Uses of R Applications of R Data types Escape Sequences Variables Keywords Operators Control statements and loops	2
	Data Structures	Vectors Lists Arrays Matrix Data Frames Factors	2

2	Data and File Handling	Reading and writing data R CSV file R Excel file R XML file R Database	2
3	R Statistics	R Mean, Median & Mode R Linear Regression R Normal Distribution R Binomial Distribution R Time Series Analysis R Random Forest R Chi Square Test Support with the machine Neural network Nearest neighbour	5
	R Graphics	R Plot, R Line, R Pie Chart, R Bars	
4	R applications in Biotechnology	Use various R functions to solve biological problems	2
Total Number of Lectures			**15**

METHODOLOGY:

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

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*		15
Attendance	-------	5
End Semester Exam		30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

References:

1. Thulin, M. (2024). Modern Statistics with R: From wrangling and exploring data to inference and predictive modelling. CRC Press

2. Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). R for data science. " O'Reilly Media, Inc.".

3. Weinberg, S. L., Harel, D., & Abramowitz, S. K. (2023). Statistics using R: an integrative approach. Cambridge University Press.
4. Kabacoff, R. (2022). R in action: data analysis and graphics with R and Tidyverse. Simon and Schuster
5. Wimberly, M. C. (2023). Geographic Data Science with R: Visualizing and Analyzing Environmental Change. Chapman and Hall/CRC.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BI 501.1	3	2	2	-	-	2	-	-	2	2	-	3	2	1	
BI 501.2	3	2	2	-	-	2	-	-	2	2	-	3	2	2	1
BI 501.3	3	3	3	-	-	3	-	-	3	3	-	3	2	2	2
BI 501.4	2	2	2	1	3	2	-	1	2	2	2	2	2	2	3

COURSE: MOLECULAR MODELING AND DRUG DESIGNING

COURSE CODE: BI 502	**L**	**T**	**P**	**Hr**	**C**
MARKS: 150 (Theory 50 + Practical 100)	**2**	**0**	**4**	**6**	**4**

OBJECTIVES:

To familiarize the students with molecular modeling concepts and molecular modeling software's.
To enable students in practicality of modeling of varios molecules

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BI 502.1	Explain molecular modelling and relate the concepts of mathematics such as matrices and coordinates in computational representation and calculation of molecular properties
BI 502.2	Illustrate various molecular file formats
BI 502.3	Acquire the concepts of molecular and quantum mechanics including dynamics, and discuss energy minimization algorithms
BI 502.4	Design novel lead molecules and optimize existing drugs using structure and ligand based drug designing approaches

PREREQUISITES

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction to Molecular modeling and chemoinformatics	History, importance and application	01
	Molecular Graphics Representation	Representation of molecules using co-ordinates, Matrices and tables	06
	Building of molecules	Building of small molecules, Building of Biopolymers DNA & oligopeptides in different secondary structure	02
2	Molecular File Formats	SMILES, mol, mol2, sdf, pdb etc.	04
3	Optimization of geometries (Molecular Mechanics and Quantum Mechanics)	Energy calculation using force fields and Schrodinger equations	04

	Geometry Optimization	Energy minimization by systematic search Method, Gradient based Energy minimization, Monte Carlo method, Genetic algorithm and simulated annealing.	04
4	Drug design Methods	Ligand and structure based drug design	09
Total Number of lectures			**30**

METHODOLOGY

The course will be taught through lectures, exercises, participative learning, videos and and supported by Practicals.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 mins	15
Attendance	----	5
End Semester Exam	1 hour 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

PRACTICALS IN MOLECULAR MODELING & DRUG DESIGNING

(4 HOURS PER WEEK) **MARKS: 100**

List of practicals:

1. Generating Rastor and Vector Graphics file and its importance
2. Extraction and Visualization of Macromolecules from database (Proteins & DNA) using Pymol
3. Extraction and Visualization of Macromolecules from database (Proteins & DNA) using Discovery Studio.
4. Extracting Small molecular structures from Databases by similarity Searching
5. Generating small Molecules using Fragment Library
6. Generating small molecules using drawing tools available in the software
7. Studying the protein databank file format
8. Preparation and study of different small molecular file formats
9. Studying the 2D and 3D file formats.
10. Calculation of total energy of the molecules
11. Generation of molecular conformations: Energy Minimization
12. Comparison of energies of a molecule obtained from various sources.
13. Calculation of Molecular Properties.
14. Protein and Ligand Preparation for Docking
15. Studying Protein-ligand interaction through Docking

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

REFERENCES:

1. Engel, T. & Gasteiger, J. (2018). Applied Chemoinformatics: Achievements and Future Opportunities. Wiley,.
2. Engel, T. & Gasteiger, J. (2018). Chemoinformatics: Basic Concepts and Methods. Wiley.
3. Brown, N. (2016).In Silico Medicinal Chemistry, . RSC Publishing.
4. Wild, D. (2013),Introducing Cheminformatics. LuLu.
5. Faulon, J. L. & Bender, A. (2010).Handbook of Chemoinformatics Algorithms. CRC.

6. Leach, A.R. & Gillet, V. J. (2003), An Introduction to Chemoinformatics. Springer.
7. Engel, T. & Gasteiger, J. (2003). Chemoinformatics: A Textbook. Wiley.
8. https://www.youtube.com/watch?v=tFHBQJFic9Q
9. http://www.mrc-lmb.cam.ac.uk/rlw/text/MacPyMOL_tutorial.html
10. Chemoffice Tutorial 2004
11. https://sites.ualberta.ca/~pwinter/Molecular_Docking_Tutorial.pdf
12. Practical Chemoinformatics, Karthikeyan Muthukumarasamy, Vyas Renu, Springer 2014

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BI 502.1	3	3	1	-	1	-	-	-	2	2	-	2	3	1	1
BI 502.2	1	2	-	-	2	1	-	-	1	1	-	2	1	1	1
BI 502.3	3	1	3	2	3	1	3	2	1	3	1	3	2	2	2
BI 502.4	3	3	3	3	3	3	2	2	3	3	2	3	3	3	3

COURSE: DISEASE BIOLOGY

COURSE CODE: MB 504 **L T P H C**

MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVE:

The objective of the course is to develop an understanding regarding various human diseases. The course covers detail of various infectious and non-infectious diseases.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 504.1	Outline the characteristics of diseases, their etiologies, and identify types of laboratories for disease investigation
MB 504.2	Describe the prevention and treatment of infectious diseases and analyze various immune system disorders
MB 504.3	Discuss the disorders of endocrine, digestive and cardiovascular system
MB 504.4	Identify diseases associated with aging, and examine the importance of disease management

PREREQUISITES

Since the course is advance in nature knowledge in microbiology, human anatomy and physiology is required.

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to nature and investigation of diseases	Introduction to health and disease Characteristi and features of diseases Classification of disea and introduction to epidemiology Investigating diseases: Types of pathology laboratories, role and evaluation of hospital laboratory tests.	5
	Pathogens and virulence	Introduction to pathogens, parasites and types infection Types of pathogens : Bacteria, Fungi, Helmintl Prions, Protozoans and Viruses Types and effects of microbial virulence factor (offensive and defensive).	5

2	Infectious disease and treatments	Bacterial infections of skin, eye, ear, central nervous system and respiratory system Viral infections of central nervous system, respiratory system Sepsis, Prevention and treatment of infections (antibiotics, antiviral combination therapy and surgery)	4
3	Disorders of immune syst	Introduction to the defense system and types of immunodeficiency diseases Signs, symptoms, diagnosis and treatments of i) Primary immunodeficiency diseases: SCID, CVID ii) Autoimmune Disorders: Rheumatoid Arthri Systemic Lupus Erythematosus Basics of Immunological Hypersentivities: Typ to IV	5
	Disorders of the endocrin system	Introduction to endocrine system and its disord Signs, symptoms, diagnosis and treatments of disorders linked to a) Growth hormones –Acromegaly, Gigantism b) Thyroid Glands: Hypothyroidism and Hyperthyroidism c) Adrenal Glands: Addison disorder and Cush syndrome d) Pancreas: Diabetes Mellitus e) Reproductive hormones : i) Male: Hypogonadism, Gynecomastia ii) Female: Amenorrhea and PCOS Causes and treatment of infertility in men and women	5
	Disorders of digestive an cardiovascular system	a) Introduction to GIT and common disorders Gastritis, Ulcers, Hepatitis Signs, symptoms, diagnosis and treatments of Cholelithiasis and Crohn disease b) Introduction to the circulatory system and common disorders eg: hypertension, cardiac fa and angina Signs, symptoms, diagnosis and treatments of dilated congestive cardiomyopathies and atherosclerosis	4
	Disorders linked to aging	Introduction to causes of aging, Basics of age-related disorders eg: Parkinson disorder, Alzhe disorder and Progeria	1
4	Disease surveillance	Brief history and importance of surveillance in disease management	1
Total No. of Lectures			**30**

METHODOLOGY

The course would be covered through lectures, group discussions, teaching aids and would be supported by practical.

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 504.1	2	2	3	3	-	2	-	2	3	2	3	3	2	1	1
MB 504.2	2	3	3	2	3	2	3	2	1	3	2	2	2	2	3
MB 504.3	1	3	3	2	-	1	-	-	2	3	2	3	2	2	2
MB 504.3	2	3	2	3	3	3	3	2	2	2	3	3	2	2	2

Elective I

COURSE: Elective I CANCER BIOLOGY

COURSE CODE: MB 505	**L**	**T**	**P**	**Hr**	**C**
MARKS: 50 (Theory only)	**2**	**0**	**0**	**2**	**2**

OBJECTIVES:

- The objective of the course is to develop understanding of the biology of cancer.

- The course will elaborate understanding of tumor hallmarks, carcinogens, diagnostic and therapeutic options to cancer patients.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 505.1	Outline the basic principles of cancer biology, origin and development of cancer
MB 505.2	Explain the causes of cancer and its classification based on stages and grades
MB 505.3	Analyse molecular drivers like proto-oncogenes, oncogenes and tumor suppressor genes for their roles in cancer development
MB 505.4	Evaluate the molecular and cellular mechanisms underlying cancer progression and metastasis
MB 505.5	Examine different cancer biomarkers and their diagnostic roles
MB 505.6	Discuss different treatment modalities including chemotherapy, immunotherapy and targeted therapies

PREREQUISITES:

Since the course is advance in nature, basic knowledge in biochemistry, cell biology, genetics, and molecular biology is essential.

COURSE DESCRIPTION:

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction to cancer	Cancer statistics and problems at National and International perspectives. Origin of cancer cell, Genetic, molecular and epigenetic changes in cancer cells, Tumor hallmarks, Tumor microenvironment.	3
2	Cancer progression	Basis of tumour progression, Steps in tumor progression, Cancer stem cell theory for origin of cancer, Classifications, stages and grades of tumors.	3
	Causes of cancer	Chemical carcinogenesis Endogenous & exogenous mutagens, Identification of carcinogens, Tumour initiators & tumour promoters	2
3	Molecular basis of cancer	Aberrant signaling in cancer, Cellular and viral oncogenes (Gain of Function), Deregulated apoptotic genes (Loss of functions), Genomic landscape of cancers, DNA repair response in cancer, Dysregulation of cell cycle and cell growth, mutation in apoptosis, The role of viral genes in cancer progression (DNA tumour virus (SV 40) and human papilloma virus (E6 and E7).	4
	Proto-Oncogenes and Oncogenes	Introduction to Oncogenes families Cell transforming ability of oncogene Retrovirus as a source of cancer Oncogenes: Ras, Myc, Src, Jun and Fos, Controlling factors of oncogene expressions	4
	Tumour suppressor genes	Molecular basis of tumor suppressor genes including Retinoblastoma (Rb), p53, Adenomatous polyposis coli (APC) in the development and progression of tumor.	4
4	Metastasis	Molecular basis of metastasis, steps in cell invasion, intravasation, transport, colonization, angiogenesis.	2
5	Cancer biomarkers and diagnostic options	Expanded diagnostic technique, Tumour markers, Nucleic acid based markers and mitochondrial DNA mutation markers, Epigenetic markers including DNA methylation pattern and chromatin remodeling, mitochondrial DNA	4

6	Cancer therapy	Contemporary chemotherapy, radiotherapy Emerging therapies (Targeted delivery & Synthetic lethal approaches) Inhibitors of oncogenic protein, tumour blood vessels as target for cancer therapy Tumor immunology and cancer immunotherapies	4
Total Number of Lectures			**30**

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of ICT enabled teaching aids including PPTs, Image, Videos, E-learning resources etc.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

REFERENCES:

1. The Biology of Cancer, 2nd Edition; Author(s): Robert A. Weinberg; Garland Science; 2nd edition (14 May 2013). ISBN: 9780815342205.
2. Molecular biology of the cell, Garland Science; 5th edition (November 16, 2007), By Bruce Alberts (Author), Alexander Johnson (Author), Julian Lewis (Author), Martin Raff (Author), Keith Roberts. ISBN-10: 0815341059, ISBN-13: 978-0815341055.

3. Cancer Biology, 4 edition (10 May 2007) By Raymond W. Ruddon, Oxford University press, ISBN-10: 0195096908.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 505.1	2	2	3	-	-	-	-	-	1	2	-	3	2	2	1
MB 505.2	1	3	3	2	-	2	-	-	3	2	3	2	2	2	2
MB 505.3	3	3	2	2	3	2	2	3	3	2	2	2	2	3	2
MB 505.4	3	2	3	3	2	3	1	2	3	2	2	3	2	2	1
MB 505.5	2	2	3	2	3	2	2	3	1	1	2	3	2	2	2
MB 505.6	3	3	2	2	3	2	3	2	3	2	3	2	1	2	3

COURSE: Elective –I: NANOMEDICINE
COURSE CODE: MB 506 **L T P Hr C**
MARKS: 50 (Theory only) **2 2 0 2 2**

OBJECTIVES:

- To create general understanding amongst the students in the subject of Core nanotechnology and its applied parts Nanomedicine through in-depth lectures & laboratory practical.
- To understand them a general overview, concepts and basic principles in the subject of Nanomedicine with emphasis for project in the field of nanotechnology.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 506.1	Comprehend basic terminologies of nanobiotechnology, nanomaterials and nanotools
MB 506.2	Apply the knowledge of nanomedicine in various fields such as drug delivery and cancer therapeutics
MB 506.3	Explain the use of different nanostructures to develop scaffolds, implants, and surgical instruments for application in 2D and 3D cell culture, tissue engineering and surgery
MB 506.4	Describe different *in vivo* and *in vitro* nanodiagnostic tools in medicine

METHODOLOGY

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

COURSE DESCRIPTION

Sr. No.	Topic	Detailed syllabus	No. of Lectures
1	Introduction and Basics	Basics of nanotechnology, nanomaterials and nanoparticles	3
2	Nanoparticles in drug delivery and cancer therapeutics	Types of nanoparticles based drug delivery, Nanoparticles for targeted drug and gene delivery, Nanoparticles and hyperthermal ablation, tumor ablation, in vivo anticancer delivery	6

3	Nanofiber based scaffolds and tissue engineering	Composition and types of nanofiber, methods of synthesis of nanofiber, application of nanofibers in tissue engineering	4
	Nanotechnology in neuroscience	Nonmaterial scaffolds for neuroregenerative medicine, and neuroprotection scaffolds.	4
	Nanotechnology and surgery	Implants and surgical instrument design, nonplusses, Nanocoatings, laser assisted nanosutures, nanofiber based bandage, intracellular nanosurgery	4
	Nanomaterials for cell culture	2D and 3D cell cultures, synthetic and natural nanofiber scaffolds, cellularisation of nanofiber and cellular trafficking	5
4	Nanodiagnostics	*In vitro* and *In vivo* nanodiagnostics (using gold nanoparticles, nanotubes, and quantum dots) nanobiochips.	4
Total Number of Lectures			**30**

EXAMINATION SCHEME (THEORY)		
Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 506.1	2	2	-	-	-	2	-	-	1	2	-	2	2	1	1
MB 506.2	2	3	2	2	3	3	2	2	3	3	2	2	2	2	1
MB 506.3	3	2	3	3	3	2	2	3	2	2	3	3	2	2	2
MB 506.4	3	3	2	1	2	2	2	3	2	3	2	2	2	2	2

COURSE: SCIENCE COMMUNICATION

COURSE CODE: BTSEC501	**L**	**T**	**P**	**Hr**	**C**
MARKS: 50 (Practical only)	**0**	**0**	**2**	**2**	**1**

OBJECTIVES:

- To train the students for communicating science in simple language as well as understand and present a particular topic, published research work in front of an audience
- To develop capability and potential to discuss, delineate a topic precisely, professionally in an interactive manner
- To prepare science columns, science videos, science animations and science blogs for effective public outreach

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
BTSEC501.1	Comprehend scientific articles and communications
BTSEC501.2	Communicate science to public in simple ways through articles, cartoons, blogs
BTSEC501.3	Communicate science to public in simple ways through animations, videos,
BTSEC501.4	Relate ethics in Science communication

Sr. No.	Practical / Workshop	Contact hours
1	Modes of Professional Scientific Communication	02
2	Structure of research article	02
3	Interpreting the scientific data and writing a popular science article	04
4	Interpreting the scientific data and writing a blog	04
5	Interpreting the scientific data and making a science animation	08
6	Interpreting the scientific data and making a science video	08
7	Ethical practices in science communication	02
	Total	**30**

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Continuous Internal Assessment		
Attendance		20
Presentations/Report/Video/Blog/Article/Animation		30
Total		**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTSEC501.1	1	1	-	-	-	2	-	-	1	3	-	1	1	-	-
BTSEC501.2	1	1	-	-	2	2	-	1	2	3	-	1	1	-	-
BTSEC501.3	1	1	-	-	2	2	-	1	2	3	-	1	1	-	-
BTSEC501.4	1	1	-	-	-	2	-	3	1	1	-	1	1	-	-

COURSE: APTITUDE BUILDING-V

COURSE CODE: BTAEC501 **L T P Hr C**

MARKS: 50 (Practical only) **0 0 2 2 1**

OBJECTIVES:

- To enhance the logical reasoning skills of the students and help them improve the problem-solving abilities
- To acquire skills required to solve quantitative aptitude problems
- To boost the verbal ability of the students for academic and professional purposes

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC501.1	Apply critical thinking skills, such as problem solving related to their subject matter
BTAEC501.2	Demonstrate competency in verbal, quantitative and reasoning aptitude
BTAEC501.3	Display good written skills for use in academic and professional scenarios
BTAEC501.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact hours
1	Essential Grammar	02
2	Vocabulary for placements	04
3	Verbal Ability	08
4	Presentation & Writing skills for placements	04
5	Quality and regulatory documentation	02
6	Bioreactor design and process optimization	02
7	Enzyme-based sensors	02
8	Competitive Examination Preparation	02
9	Mock Interviews	02
10	Discussion session-Industry Experts/Academia Experts/Alumni	02

	Total Practical/Training Hours	30

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Continuous Internal Assessment		20
Attendance		
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

BOOKS RECOMMENDED:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing

2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.

3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTAEC501.1	-	2	2	1	2	-	-	-	-	1	-	2	2	-	-
BTAEC501.2	1	1	1	-	-	-	-	-	-	1	-	1	1	-	-
BTAEC501.3	1	1	1	-	2	-	-	-	-	2	-	1	1	-	-
BTAEC501.4	1	1	1	-	1	-	-	-	-	1	-	1	1	-	-

SEMESTER VI						
MB 601	Biomedical Devices and Instruments	2	0	0	2	2
MB 602	Artificial Organs and Biomimetics	2	0	0	2	2
HU 601	Health Care Law Management	2	0	0	2	2
MB 604	Genomics, Transcriptomics & Proteomics	2	0	4	6	4
MB 603	Molecular Diagnostics	2	0	2	4	3
BI 601	Artificial Intelligence	1	0	2	3	2
MB 605/606	Elective II	3	0	0	3	3
BTIKS601 (Indian Knowledge Systems)	Indian Constitution and Law	1	0	0	1	1
BTSEC601	Foreign Language Course German/French/Japanese/Korean/Spanish/ any other (online MOOCs/offline)	2	0	0	2	2
BTAEC601 (Ability Enhancement)	Aptitude Building-VI (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
	Total	**17**	**0**	**10**	**27**	**22**
Elective II : (Vaccine Technology/ Personalized Medicine)						

COURSE: BIOMEDICAL DEVICES AND INSTRUMENTS

COURSE CODE: MB 601	**L**	**T**	**P**	**H**	**C**
MARKS: 50 (Theory only)	**2**	**0**	**0**	**2**	**2**

OBJECTIVES:

- To familiarize the students with various modern biomedical equipment.
- To create general understanding among the students regarding application as well as advantages and disadvantages.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 601.1	Outline the principles of bioelectronic signal generation and their acquisition
MB 601.2	Determine the parameters of cardiac and respiratory activity measurements and required instrumentation
MB 601.3	Illustrate the use of electroencephalography and radiography techniques in medical diagnostics
MB 601.4	Summarize various patient monitoring systems and essential precautionary measures

PREREQUISITES:

Students must have basic knowledge of physics and electronics as well understanding of human anatomy and physiology.

COURSE DESCRIPTION:

Unit	Topic	Detailed syllabus	No. of Lectures

1	Bioelectric signals and Electrodes	Action potential and Resting potential - Electrodes for ECG, EEG, EMG – Electrode – Electrolyte interface – Half Cell Potential – Different types of amplifies like Bioelectric amplifiers – Isolation amplifiers etc.	04
2	Cardiac Activity Measurement Systems	ECG, sources of ECG, Normal and Abnormal waveform, Diagnosis interpretation – ECG Leads – ECG Recorder – Cardiac output measurements	03
	Respiratory System Measurements	Mechanics of breathing – Parameters of Respiration – Respiratory Volume Measurement – Spirometers – Respiratory Gas Analyzers – Oxygen Therapy – Introduction about Ventilators	03
3	Instrumentation For Measuring Brain Function	Electroencephalography (EEG) Signal Amplitudes and Frequency Bands – EEG Machine	04
	Biomedical Imaging	Radiography (X-Rray) – Magnetic Resonance Imaging (MRI) – Nuclear medicine – Ultrasound, Endoscope – CT scan	08
4	Patient Monitoring Systems	Patient Monitoring Systems – Bedside Monitors – Central Monitors – Measurement of heart rate, – respiration rate and temperature	04
	Patient safety	Electric Shock Hazards – Microshock – Macroshock – Leakage Currents – Types of Leakage currents – Precautions to minimize Electric Shock Hazards-Safety code for Electromedical Equipment	04
Total number of Lectures			**30**

EXAMINATION SCHEME (THEORY)

Examination	Duration	Marks
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		50

*Average of Internal I (15 marks) and Internal II (15 marks)

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 601.1	1	2	3	-	2	2	-	-	2	2	-	2	3	1	1
MB 601.2	2	3	2	3	3	2	-	2	2	2	-	3	3	2	2
MB 601.3	3	2	3	2	3	1	2	1	2	2	-	3	3	2	2
MB 601.4	1	3	2	3	2	2	3	3	3	3	2	2	3	2	3

COURSE: ARTIFICIAL ORGANS AND BIOMIMETICS

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

MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVES:

- To familiarize the students with different types of technologies used for creation of artificial organs to overcome human disabilities
- To enable the student to understand the biomimetic science in Artificial Organs, Tissue Engineering and other medical applications.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 602.1	Outline different artificial organs and associated clinical and ethical considerations
MB 602.2	Evaluate various engineering parameters in artificial organs
MB 602.3	Illustrate specialized types of organ-like technologies
MB 602.4	Classify different tissue-engineered artificial organs
MB 602.5	Discuss the applications of different artificially engineered organs
MB 602.6	Apply the concepts of biomimetic in tissue engineering

PREREQUISITES

Students should have studied basic Human Anatomy and Physiology, Tissue Engineering, Animal Tissue Culture.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of

			lectures
1	Introduction to artificial organs	Introduction, Outlook for organ replacement, Clinical considerations, Substitutive medicine and ethics.	04
2	Engineering Consideration regarding Artificial Organs	Biomaterials and Biocompatibility, Mechanical Properties Testing, Types of Materials Structure/Function Relationsh in Biomaterials Failure Mechanisms in Biomaterials Surface Properties and Host Response (Biocompatibility) Design Principles for Tissue and Blood Contact Artificial exchange systems Power Systems for Implanted Systems Control of Artificial Organs Evaluation Processes	07
3	Organ-like substitutes	Prostheses (eg. Limbs, ocular, heart valves, stents, synthet vascular grafts, total knee replacement) Non-living external devices (eg. Heart-lung machine, ventricular assist devices, haemodialysis machine, periton dialysis and automated artificial wearable kidney, hemofiltration device, artificial pancreas, artificial lung), Non-living intracorporeal devices (eg. Total artificial hear ventricular assist devices, heart pacemaker, intravascular artificial lung, implantable artificial pancreas)	08
4	Specialized types of organ-technologies	External biohybrid devices (eg. Bioartificial kidney, extracorporeal liver assist device, biohybrid lung), Intracorporeal biohybrid devices (eg. Implantable bioartifi liver, kidney), Bionic technology (eg. Bionic ear, eye, arm), brain-compu interface technology, Artificial blood, artificial cells, Organs-on-a-chip	08
5	Tissue-engineered artificia organs	Tissue engineered heart valves, blood vessels, myocardial patch, whole heart. Tissue-engineered skin substitutes (different types of epidermal, dermal and composite skin replacements for bu and non-healing wounds), melanocytes for vitiligo, *in vitr* melanoma model for drug testing. Tissue engineered bone (cells, materials, demineralized bo matrix, bone morphogenetic proteins, examples of bone	10

		substitutes) Tissue engineered cartilage, autologous chondrocyte implantation, autologous matrix-induced chondrogenesis, cartilage substitutes Neural tissue engineering (different types of cells involved nerve repair, peripheral nerve guidance conduits, stem cell therapy for Parkinson's and Alzheimer's disease) Commercialized tissue engineered products	
6	Biomimetics	Introduction to biomimetics, Biological mechanisms, natural mechanisms and biomime structures, biomimicry at the cell-material interface, Tissue structure and biomimetic applications, biomimetic composites, electroactive polymers, biological functional surfaces, Biomimetic products, biomimetic for medical implants, biomimetic applications in medical device design, biomim and bioengineering applications, Biomimetics and challenges	08
Total Number of Lectures			**45**

METHODOLOGY

The course will be taught through lectures, exercises, participative learning, videos.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED

1. Artificial Organ Engineering by Maria Cristina Annesini, Luigi Marrelli, Vincenzo Piemonte (Authors), Springer 2016

2. Artificial Organ Engineering, By Maria Cristina Annesini, Luigi Marrelli, Vincenzo Piemonte, Luca Turchetti, Publisher Springer London 2016, 978-1-4471-6442-5

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 602.1	3	3	1	3	1	3	3	3	2	3	-	2	3	1	2
MB 602.2	2	1	1	3	1	3	3	3	2	3	-	2	3	3	3
MB 602.3	2	2	3	3	1	3	3	3	2	3	-	2	3	3	3
MB 602.4	3	3	2	3	1	3	3	3	2	3	-	2	1	1	1
MB 602.5	1	3	3	3	2	3	3	3	2	3	-	2	2	3	3
MB 602.6	2	2	3	3	2	3	3	3	2	3	-	2	2	2	3

COURSE: HEALTHCARE LAW MANAGEMENT

COURSE CODE: HU 601 **L T P H C**

MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVES:

- To develop understanding of the legal and regulatory framework in the healthcare sector.
- To train the students in management skills focusing towards healthcare services.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
HU 601.1	Analyze legal and regulatory framework governing the healthcare industry, including key statutes and regulations
HU 601.2	Summarize basics of quality improvement and use of information technology in healthcare
HU 601.3	Plan cost management in healthcare including financial healthcare and insurance
HU 601.4	Acquire awareness of healthcare laws, fraud and abuse, and management of healthcare professionals

PREREQUISITES

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

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of Lectures
1	Overview	Need of management in healthcare, management definition, function and competencies.	2
	Strategic planning	Purpose and importance of planning, SWOT analysis, planning & designing of healthcare facilities, role of health care manager	3
	Healthcare marketing	Marketing basics, history of marketing healthcare, healthcare buyer behavior	2
2	Quality improvement basics	Defining quality in healthcare, key leaders in quality improvement, common elements and tools in quality improvement	3
	Use of information technology	Use of information system by managers, the electronic medical record, challenges to clinical system adaptation	2
	Financing health care and insurance	Introduction and history of health insurance, characteristic of health insurance, social insurance, coverage and costs, uninsured	3

3	Cost of healthcare management	Financial management definition and importance, reimbursement from third party, controlling cost and accounting, setting charges; managing working capital, account receivable, budget	5
	Managing healthcare professionals	Physicians and nurses, home health aids, midlevel practitioners, allied health professionals	2
4	Fraud and abuse	Defining fraud and abuse, antitrust issue, corporate compliance program	3
	Introduction to healthcare law	Laws related to healthcare, Human material transfer, organ and tissue procurement; sell of body parts, procurement and sell of sperm and ova; laws related to abortions, contraception.	5
Total Number of Lectures			**30**

METHODOLOGY

The entire course is covered through lectures, group discussions and with the help of teaching aids.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hours 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
HU 601.1	-	-	-	-	-	-	3	3	3	2	2	3	1	-	1
HU 601.2	2	3	2	-	3	-	2	3	3	2	2	2	1	-	1
HU 601.3	-	-	3	2	3	3	-	3	3	2	3	2	1	-	3
HU 601.4	-	-	-	3	2	2	3	2	2	2	2	2	-	-	3

COURSE: GENOMICS, TRANSCRIPTOMICS & PROTEOMICS
COURSE CODE: MB 604 **L T P H C**
TOTAL MARKS: 150 (Theory 50 + Practical 100) **2 0 4 6 4**

OBJECTIVES:

The recent proliferation of genomic data has transformed biology, making previously laborious and expensive experiments easier and cheaper, enabling new avenues of inquiry, and fundamentally altering our understanding of biology and medicine. This course will introduce to the questions that can be asked and answered with genomic data, and to the computational tools available to analyze that data.

COURSE OUTCOMEs:

CO No.	At the end of the course, the learner should be able to:
MB 604.1	Outline the genome organization and various tools used for genome analysis
MB 604.2	Demonstrate the concept of transcriptome and the tools involved in its analysis
MB 604.3	Employ microarray and various sequencing techniques including NGS for genomic and transcriptomic studies
MB 604.4	Illustrate the concept and tools for analysing proteome of organisms
MB 604.5	Elucidate the principles and usage of tools for studies in metabolomics
MB 604.6	Planning and implementation of advanced techniques including mass spectrometry, GCMS etc. for protein and metabolite identification

Prerequisite: Basic knowledge of molecular biology, Recombinant DNA technology and Bioinformatics is required.

Sr. No.	Units	Detailed syllabus	No of lectures
1.	Genomics	Structure and organization of prokaryotic and eukaryotic genomes- nuclear, mitochondrial and chloroplast genomes. Databases different types DNA databases, Tools for finding genes and regulatory regions.	4
2.	Transcriptomics	Concepts of transcriptomics and its scope. Micro (mi) RNA biogenesis and its role in regulation of gene expression. Tools for analyzing gene expression: Serial Analysis of gene expression (SAGE), massively parallel signature sequencing (MPSS).	7

3	Microarray technic Genomics Transcriptomics	● Basic principles and design of cDNA and oligonucleotide arrays, DNA microarray. Basic steps involved in designing a microarray experiment. ● Types of microarray based on its applications:- Expression arrays, Comparative Genomic Hybridization (CGH) arrays, Re-sequencing arrays. ● Different microarray platforms (Affymetrix, Agilent etc.); Tools used to normalize microarray Data. ● Microarray databases – NCBI; GEO (Gene Expression Omnibus), Array Express (EBI); ● Functional Analysis: Gene Ontology functional enrichment tools, Pathway analysis (KEGG Database)	12
	Sequencing techn in Genomics transcriptomics	Next Generation sequencing (NGS): Introduction to NGS, overview and comparison of different Sequencing Platform (Illumina, 454 (Roche), SOLiD (Life technology), Specific Biosciences, Ion Torrent, Nanopore, PacBio.	4
	Types of NGS	Types of NGS: DNA-sequencing (Whole genome sequencing), exome sequencing, Deep sequencing, ChIP sequencing, RNA-sequencing (Whole transcriptome sequencing, WTS).	2
4	Proteomics:	What is proteomics?; proteome complexity; Overview of protein structure-primary, secondary, tertiary and quaternary structure. , Clinical and biomedical applications of proteomics. Post translational Modifications (PTMs): Different type of PTMs, Quantitative proteomics, clinical proteomics and disease biomarkers, mass spectral tissue imaging and profiling Bioinformatics tools in Proteomics: Protein database, Relationship between protein structure and function.Track emrging diseases and design new drugs	9
5	Metabolomics	An overview, basic sample preparation strategies- extraction, derivatization. Workflow for lipidomics; Targeted Vs Untargeted metabolomics; development of targeted assays for small molecules, Metabolomic Data Analysis:Peak detection, retention time alignment; identification of molecular features and metabolites; Structural confirmation of metabolites. Software-Multiquant, MZmine, XCMS, MarkerView,	4
6	Techniques in Protein and Metabolite Identification	Identification and analysis of proteins by 2D PAGE, Mass spectrometry: ion source (MALDI, spray sources), analyzer (ToF, quadrupole, quadruple ion trap) and detector for protein and metabolite analysis	3
Total Number of Lectures			**45**

Methodology:

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given.

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Internal*	45 mins	15
Attendance	----	5
End Semester Exam	1 hours 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Recommended text Books:

1.Primrose S.B. and Twyman R.M. (2006). Principles of gene manipulation and Genomics. "Edition VII."
2. Lesk, A. M. (2012). Introduction to Genomics, IInd edition. "Oxford University Press."
3. Liebler, D. C. (2001). Introduction to Proteomics: Tools for New Biology. 1st Edition. "New York Humana Press."
4. Mount, D. W. (2004). Bioinformatics Sequence and Genome Analysis. "Cold Spring Harbour Laboratories (CSHL)."
5. Campbell, A. M. and Benjamin, H. L. J. (2006). Discovering Genomics, Proteomics and Bioinformatic. "2 edition".

PRACTICAL IN GENEOMICS, TRANSCRIPTOMICS & PROTEOMICS (4 HOURS PER WEEK) 100 MARKS

Sr. No	Name of the experiment
1.	To determine genome size & genome complexity by Cot curve analysis
2.	To perform zoo blotting.
3.	Analyze microarray & RNA seq data
4.	To carry out quantitative real time PCR (qRT-PCR)
5.	To Isolate and analyse microRNA using polyacrylamide gel or PCR
6.	To predict possible microRNAs targeting the gene of interest.
7.	To Perform DNA sequencing
8.	To Perform 2D gel electrophoresis & identification of the protein/peptide by MALDI
9.	To carry out DNA sequence analysis from the available profile.
10.	Genome Databases.

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	40
End semester examination:	60
Total:	**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 604.1	1	3	3	3	3	2	1	-	1	2	-	3	3	1	1
BT 604.2	1	3	3	3	3	2	1	-	1	2	-	3	3	1	1
BT 604.3	1	3	3	3	3	2	1	1	2	2	2	3	3	3	3
BT 604.4	1	3	3	3	3	3	1	-	1	2	-	3	3	1	1
BT 604.5	1	3	3	3	3	2	1	-	1	2	2	3	3	1	1
BT 604.6	1	3	3	3	3	2	1	1	2	2	2	3	3	1	1

COURSE: MOLECULAR DIAGNOSTICS

COURSE CODE: MB 603 **L T P Hr C**

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

OBJECTIVES

The objective of the course is to make students understand how various molecular techniques/assays could be employed for improved diagnosis and prognosis of various human genetic disorders and infectious diseases. These studies could also shed light on the mechanisms of pathogenesis in various diseases.

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 603.1	Outline the fundamentals and scope of molecular diagnostics in medical sciences
MB 603.2	Describe chromosomal mutations, chromosome painting and cytogenetic analysis and apply the knowledge of gene sequencing techniques to diagnose genetic diseases
MB 603.3	Detect genetic disorder using molecular diagnostic techniques and employ emerging technologies like microarray, FACS, SELDI-TOF in medical diagnosis
MB 603.4	Classify and determine the applications of biomarkers in disease prediction and diagnosis

PREREQUISITES

Students need to have a good understanding of techniques used in cell and molecular biology and biology of various diseases/disorders

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to Molecular Diagnostics	History and evolution of diagnostics, Significance and scope of molecular diagnostics.	2
2	Chromosomes, Cytogenetic Analysis	Analyses of genome and chromosomal mutations; banding of chromosomes and karyogram analysis, Chromosome painting and spectral karyotyping for cancer, Fluorescence *in situ* hybridization (FISH) (with reference to diagnosis of Chronic myelogenous leukemia), Comparative genomic hybridization (CGH).	7
3	DNA Diagnostics	PCR-based detection of microbes and aneuploidy (with reference to diagnosis of Down syndrome), ARMS-PCR (with reference to diagnosis of Cystic fibrosis), Southern blotting based diagnostics (for Fragile X syndrome), and DNA sequencing (Sanger and NGS methods).	5

	Clinical Diagnostics	Molecular detection of inherited diseases; Sickle cell disorders, Tay-Sachs disorder, Hemophilia A, Huntington chorea.	5
	Emerging Diagnostic Techniques	Microarrays, FACS, Lab-on-a-Chip approach for molecular diagnosis, Introduction to SELDI-TOF and diagnostic proteomics	4
4	Biomarkers in Disease Prediction and Diagnosis	Introduction to disease markers, FDA definition of disease biomarkers, Difference between diagnostic and prognostic biomarkers, sources for disease markers, Role of predictive biomarkers in prognosis of diseases, Emerging disease biomarkers (eg. Metabolic markers), sepsis, diabetes and cancer (eg. Breast cancer) and molecular oncologic prediction.	7
Total Number of Lectures			**30**

METHODOLOGY

The course would be covered through lectures, group discussions, teaching aids and would be supported by practical.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	----	5
End Semester Exam	1 hours 15 mins	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

BOOKS RECOMMENDED

1. Brooker, R. J. (2009). Genetics: Analysis & Principles. New York, NY: McGraw-Hill.
2. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington, DC: ASM Press.
3. Coleman, W. B., & Tsongalis, G. J. (2010). Molecular Diagnostics: for the Clinical Laboratorian. Totowa, NJ: Humana Press
4. Molecular Diagnostics: Techniques and Applications for the Clinical Laboratory Wayne W. Grody, Robert M. Nakamura, Frederick L. Kiechle, Charles Strom, Publisher: Academic Press; ASIN: B003FQM2OI, 1st Edition

PRACTICAL IN MOLECULAR DIAGNOSTICS (2 HOURS PER WEEK) MARKS: 50

Sr. No	Name of the experiment
1.	Isolation of DNA from blood or saliva [Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press.] Real-Time PCR [Green MR, Sambrook J. Analysis and Normalization of Real-Time Polymerase Chain Reaction (PCR) Experimental Data. Cold Spring Harb Protoc. 2018 Oct 1;2018(10). doi: 10.1101/pdb.top095000. PMID: 30275081.] Southern blot-based diagnosis [Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press.]
2.	Western-blot based diagnosis [Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual (4th ed.). Cold Spring Harbor Laboratory Press.] ELISA for detecting hormone or pathogen [Kohl TO, Ascoli CA. Immunoassays. Cold Spring Harb Protoc. 2017 Jul 5;2017(7):pdb.top093690. doi: 10.1101/pdb.top093690. PMID: 28679720.]
3.	Multiplex PCR to detect deletions in genes -[Nolan, T., & Bustin, S. A. (2020). *PCR technology: Current innovations* (3rd ed.). CRC Press.] Molecular diagnostics facility visits: i) Karyotyping ii) FISH iii) Flow-cytometry Next generation sequencing

**These could be demonstrated to students

BOOK RECOMMENDATION:

PRACTICAL EVALUATION SCHEME

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 603.1	1	1	1	1	1	-	-	1	1	1	-	2	3	1	1
MB 603.2	1	2	1	2	1	1	1	1	1	1	1	2	3	3	1
MB 603.3	1	2	2	2	1	1	1	1	1	1	1	2	3	3	1
MB 603.4	1	2	2	2	1	1	1	1	1	1	1	2	3	3	3

COURSE: ARTIFICIAL INTELLIGENCE
COURSE CODE: BI 601 **L T P Hr C**
MARKS: 50 **1 0 2 3 2**

OBJECTIVE:

This course introduces the concepts and state-of-the-art research in bioinformatics, data mining and AI especially for medical application

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BI 601.1	Identify and analyse the application areas using AI
BI 601.2	Select search algorithms in AI based applications
BI 601.3	Employ probabilistic reasoning in AI based applications
BI 601.4	Create biological applications using Machine Learning and Deep learning methods

COURSE DESCRIPTION:

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to AI	Introduction to AI, history and scope, Application areas, Heuristic search, Algorithms	2
2	Search Algorithms	Random search, Search with closed and open list, Depth and Breadth first search	2
3	Probabilistic Reasoning	Probability, conditional probability, Bayes Rule, Bayesian Networks	1
4	Introduction to Machine Learning	Supervised & Unsupervised Learning	4
	Introduction to Deep Learning	Neural networks, Computer Vision, Natural Language Processing	3
	Application of AI in Biological Sciences	Case Study	4
Total Number of Lectures			**16**

METHODOLOGY:

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

EXAMINATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal	45 minutes	20
End Semester Exam	1 hour 15 minutes	30
Total		**50**

PRACTICALS IN ARTIFICIAL INTELLIGENCE (2 HRS. PER WEEK) 50 MARKS

Sr. No.	Name of the experiment
1	Basic foundation of Python and acquainted with IDE such Jupyter Notebooks
2	Practical implementation of python libraries such as NumPy, Pandas, and Matplotlib for data manipulation and visualization
3	Basic understating Libraries such as Scikit-learn, TensorFlow and Dataset such as Kaggle.
4	Implementation of Linear Regression, K-Means, SVM, Naïve Bayes classifier and Random Forest algorithm (at least two) by using Scikit-learn libraries
5	To build an AI system using convolution neural networks (CNNs) and Python that can detect pneumonia from a patient's X-ray images
6	To build a chatbot using Python
7	To build a recommendation system for customers for products with the help of ANN, data mining, machine learning, and programming

PRACTICAL EVALUATION SCHEME

Examination Marks

Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

BOOKS RECOMMENDED:

1) Géron, A. (2022). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow*. " O'Reilly Media, Inc."

2) Boden, M. A. (2018). Artificial intelligence: A very short introduction. Oxford University Press.

3) Russell, S. J., & Norvig, P. (2016). Artificial intelligence: a modern approach. Pearson

4) Poole, D. L., & Mackworth, A. K. (2010). *Artificial Intelligence: foundations of computational agents*. Cambridge University Press.

5) Russell, Stuart. "Human-Compatible Artificial Intelligence." (2022): 3-23

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BI 606.1	2	2	2	-	2	2	-	-	3	2	-	3	2	1	-
BI 606.2	3	3	2	2	3	1	-	-	1	2	-	2	2	2	-
BI 606.3	3	2	3	3	3	2	-	-	2	3	-	3	2	2	1
BI 606.4	2	2	3	3	3	2	2	2	3	2	2	2	2	2	2

COURSE: VACCINE TECHNOLOGY (ELECTIVE II)
COURSE CODE: MB 605 **L T P Hr C**
MARKS: 100 **3 0 0 3 3**

OBJECTIVE:

The objective of the course is to develop the concept behind vaccine production and development.

LEARNING OUTCOME:

CO No.	At the end of the course, the learner should be able to:
MB 605.1	Explain the fundamental concepts and principles of vaccine design
MB 605.2	Demonstrate various approaches in vaccine discovery and biophysical characterization of vaccine formulations
MB 605.3	Analyse the basics of antigen and antigen engineering including its application
MB 605.4	Illustrate various vaccine delivery systems
MB 605.5	Demonstrate the optimization and evaluation of vaccine efficacy
MB 605.6	Comprehend efficient strategies for implementation of mass immunization and its safety

PREREQUISITES:

Knowledge of immunology, cell and molecular biology is required**.**

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. o Lectur
1	Introduction	Concept and scope of modern vaccine.	2
	Principles of Vaccine Design	Stimulation of innate immunity, antigen processing and presentation, mucosal immune system, role of adjuvants, immunological memory, mouse and primate as models for vaccine design, e.g. vaccine for HIV.	8
2	Antigen Discovery	Computational approach for vaccine discovery and design, high throughput proteomic screening, phage library, biophysical characterization of vaccine formulations.	8
3	Antigen Engineering	Attenuated bacteria vaccine, antigen scaffold, recombinant MVA vaccine, adenovirus, avipoxvirus, cancer immunotherapy, nucleic acid vaccination, artificial antigen presenting cells.	10

4	Delivery Systems	Vaccine patch deliver system, needle free jet injection system, oral vaccine, ISCOMs, virus like particles, nanoparticles.	6
5	Evaluating Vaccine Efficacy	Formulation optimization and stability evaluation, immune monitoring design, clinical developmental strategy.	5
6	Implementing Immunizations	Mass immunization strategy, types of vaccination strategies, filing procedures of Investigational New Drug (IND), vaccine safety.	6
Total Number of Lectures			**45**

METHODOLOGY: The course will be taught through lectures, exercises, participative learning, videos.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
I Internal	1 hour	20
II Internal	45 mins	15
Attendance	----	5
End Semester Exam	2 hours 30 mins	60
Total		**100**

BOOKS RECOMMENDED:

1. Vaccinlogy: Principles and Practice. By (Ed) W W. John W. Morrow (Editor), Nadeem A. Sheikh (Editor), Clint S. Schmidt (Editor), D. Huw Davies (Editor), Publisher**:** Wiley-Blackwell; ISBN-13: 978-1405185745.

2. Development of Vaccines: From Discovery to Clinical Testing, Manmohan Singh (Editor), Indresh K. Srivastava (Editor), Publisher**:** Wiley-Blackwell; ISBN-13: 978-0470256374.

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
MB 604.1	3	3	3	-	-	3	-	3	3	3	-	3	1	1	1
MB 604.2	3	2	2	2	2	2	2	2	2	3	2	3	2	2	2
MB 604.3	3	2	2	2	2	2	2	3	2	2	2	3	2	2	2
MB 604.4	3	3	3	2	2	2	3	3	3	3	2	3	1	2	2
MB 604.5	3	2	2	2	2	2	3	3	3	3	2	3	2	1	2
MB 604.6	3	3	3	2	2	2	3	3	3	3	3	2	2	2	2

COURSE: PERSONALIZED MEDICINE (ELECTIVE II)

COURSE CODE: MB 606 **L T P H C**

MARKS: 100 (Theory only) **3 0 0 3 3**

OBJECTIVES:

To develop a thorough understanding of treatments that are tailor-made to counter diseases. and suit individual health requirements for effective treatment, based mainly on the differences among the molecular background of individuals.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 606.1	Determine the evolution and translation of human genomic and environmental factors into diagnosis and treatments for personalized medicine
MB 606.2	Explore genomic, pharmacoproteomic, and metabolomic approaches for the development of biomarker-based personalized medicine
MB 606.3	Design RNA therapy, gene therapy, and vaccine therapy-based personalized protocol for the diagnosis and treatment of human diseases using GWAS, bioinformatics tools, and AI
MB 606.4	Conceptualize epigenomics, microbial factors, and specialized databases in the development of personalized medicine
MB 606.5	Appreciate the importance and implications of personalized medicine in the management of various human diseases
MB 606.6	Restate ethical, social and privacy issues, and challenges in the development of personalized medicine

PREREQUISITES

This course is advanced in nature, thus, a sound knowledge of molecular biology, genetics and genetic engineering is required.

COURSE DESCRIPTION

Unit	Topic	Detailed syllabus	No. of lectures
1	Introduction to personalized medicine	History and evolution of personalized medicine Structure and dynamics of human genome and epigenome Understanding genetic variations in the context of human diseases Concepts in pharmacogenomics and pharmacogenetics	4

2	Basis for the development of personalized medicine	Adverse drug reactions and distributions of genetic polymorphisms influencing drug efficacy. Basis of pathological and neutral genomic variations, ethnic and gender variations in drug metabolism for clinical applications. Personalized approach to environmental factors in disease. Molecular Diagnostics as basis for personalized medicine.	7
3	Omic Technologies and Molecular Biomarkers	Introduction to Omics Technologies, Pharmacoproteomics, Metabolomics in personalized medicine. Different types of molecular biomarkers as effective predictive tools for drug responses in clinical practice	6
4	Advanced therapeutic strategies	Designing a personalized protocol for diagnosis and treatment of human diseases. Personalized Biological therapies: i) RNA-based therapeutics and genome editing techniques, description of drug delivery systems, use of cell therapy and iPSCs. ii) Gene therapy approaches in personalized medicine. iii) Personalized vaccines. Artificial Intelligence, Computer Aided Drug Design (CADD), Genome Wide Association Studies (GWAS) in developing personalized medicine. Personalized Approaches to treating inherited diseases	7
5	Additional elements in development of personalized medicine	Involvement of Non-genomic and Epigenomic factors, Circadian rhythms, Gut microbiome and Molecular imaging in development of personalized medicine Roles of Genetic Banking systems and Bioinformatics, general databases (dbSNP, Clinvar and OMIM) and integration of technologies in development of personalized medicine.	7
6	Case studies in personalized medicine	Case studies of the application of personalized medicine in Cancer, Pain relief and Cardiology. Personalized Management of Neurodegenerative disorders (Parkinson and Huntington disease), HIV infection, Lactose intolerance.	7
6	Ethics, Economics and Future of Personalized Medicine	Ethical issues in: Pharmacogenetics and Whole genome analysis, Genotype-specific clinical trials. Social and privacy issues. Affordability of personalized medicine, Personalized medicine and Orphan Drugs.	7

		Personalized prognosis of disease, Personalized preventive medicine, Pharmacotyping, Challenges in delivery of personalized medicine.	
Total Number of Lectures			**45**

METHODOLOGY:

The entire course will be covered through lectures, group discussions and with the help of teaching aids.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal I	60 minutes	20
Internal II	45 minutes	15
Attendance		05
End Semester Exam	2 hours 30 minutes	60
Total		**100**

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
MB 605.1	2	3	3	2	2	3	3	2	2	2	2	3	2	2	3
MB 605.2	3	2	3	3	3	2	2	1	2	1	3	2	2	2	3
MB 605.3	3	3	2	2	3	3	2	2	2	1	1	2	3	3	3
MB 605.4	2	2	3	3	2	2	3	1	2	2	2	2	2	3	2
MB 605.5	1	3	2	2	2	2	3	2	3	3	2	2	2	2	1
MB 605.6	1	2	3	2	3	3	3	3	2	2	3	3	2	2	3

COURSE: INDIAN KNOWLEDGE SYSTEM: INDIAN CONSTITUTION AND LAW

COURSE CODE: BTIKS601 **L T P Hr C**

MARKS: 50 (Theory only) **1 0 0 1 1**

OBJECTIVES:

- To provide the students an introduction of Indian Constitution,
- To make the student understand its basic constituents and overview on the legal system in this country

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
BTAEC501.1	Recognize the importance, sources, structure and principles of Constitution of India
BTAEC501.2	Comprehend the composition and powers of Parliament and State Legislatures
BTAEC501.3	Know the significance of local governance.
BTAEC501.4	Appreciate the structure and roles of judiciary in India

PREREQUISITES

Any student who has passed the Intermediate/ISC Class-XII/AISSE of CBSE or equivalent examinations in India or abroad.

COURSE DESCRIPTION

Sr. No.	Topics	Detailed syllabus	No. of Lectures
1	Introduction to the Constitution of India	The Constitution of India and the Preamble. Sources and features of Indian Constitution. Citizenship, Fundamental Rights and Duties Directive Principles of State policy. Concept of Federalism, Federalism in India: Relationship between Central and State Governance. The three pillars of Indian Governance: Parliament, Executive and Judiciary. Roles of Election Commission in India.	3
2	Union Government and it administration	Legislature: Lok Sabha, Rajya Sabha, and their powers and roles. Executive: Appointments, powers and roles of President, Vice-President, Prime Minister and Council of Ministers. Introduction to civil services in India. Judiciary: Authorities and roles of the Supreme Court and the High Court.	3
3	State Government and it administration	Legislative Assembly, Legislative Council, their control and functions. Appointments, powers and roles of Governor, Chief Minister and Council of Ministers of the State.	3

4	Local Governance in India	Evolution of Local Governance in India. Composition of District Administration, their authorities and roles. Importance of Municipalities. Panchayati Raj: Composition and their functions, 73rd and 74th Amendments in the Constitution of India, importance of Zilla Parishad, Panchayat Samiti and Gram Panchayat.	3
5	Indian Legal System	Jurisprudence, its evolution and types (in brief). History and significance of legal systems in India. Basics of Indian laws and their types. Enactment of laws, Law commission in India Alternate Dispute Redressal. Personal and International laws in India.	3
Total Number of Lectures			**15**

METHODOLOGY

The course will involve the conduct of a series of lectures to understand the various aspects of Constitution of India and an overview on the laws of the land.

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hour 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BTAEC501.1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
BTAEC501.2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
BTAEC501.3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
BTAEC501.4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

COURSE: FOREIGN LANGUAGE
COURSE CODE: BTSEC601 **L T P Hr C**
2 0 0 2 2

MARKS: 50 (Theory only)

OBJECTIVE
To develop students' proficiency in speaking, reading and writing in foreign language. Additionally to help promote communication across linguistic barriers, enhance cultural awareness and widen the horizon for future endeavors.

DESCRIPTION
The students are given an option to choose any one from the languages - German/ French/ Japanese/ Korean/ Spanish for the offline course. Two of the most favored languages among these are considered for the offline course, while the students are free to opt for any other language through the online MOOCs, provided it fits in the semester tenure.
At the end of the semester the students need to earn a certificate on the basis of which they will be given credits out of two.

COURSE: APTITUDE BUILDING-VI

COURSE CODE: BTAEC601	**L**	**T**	**P**	**Hr**	**C**
MARKS: 50 (Practical only)	**0**	**0**	**2**	**2**	**1**

OBJECTIVES:

1. Help to trigger the students' logical thinking skills and apply it in the real-life scenarios
2. Learn to deploy the strategies of solving quantitative ability problems
3. To expand the verbal ability of the students
4. Assist to run the gamut of employability skills

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC601.1	Proficiency development in interacting and using decision making models effectively
BTAEC601.2	Comprehend the given concepts expressly to deliver an impactful presentation
BTAEC601.3	Aacquire a knowledge of solving quantitative aptitude and verbal ability questions effortlessly
BTAEC601.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact Hours
1	Logical Reasoning puzzles - Advanced	02
2	Logical connectives, Syllogism and Venn diagrams	02
3	Permutation, Combination and Probability - Advanced	04
4	Quantitative Aptitude	06
5	Image interpretation	02
6	Critical Reasoning - Advanced	02
7	Genome, transcriptome and proteome analysis	02
8	Market Survey/Market Intelligence	02
9	Bioindicators	02

10	Competitive Examination Preparation	02
11	Mock Interviews	02
12	Discussion session-Industry Experts/Academia Experts/Alumni	02
	Total Practical/Training Hours	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	**Duration**	**Marks**
Continuous Internal Assessment		20
Attendance		
Assignments/Practical/Training/Tests/Interviews		30
Total		**50**

REFERENCES:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing

2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.

3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
BTAEC601.1	-	2	2	1	2	-	-	-	-	1	1	2	2	-	-
BTAEC601.2	1	1	1	-	-	-	-	-	-	1	-	1	1	-	-
BTAEC601.3	1	1	1	-	2	-	-	-	-	2	-	1	1	-	-
BTAEC601.4	1	1	1	-	1	-	-	-	-	1	-	1	1	1	-

SEMESTER VII						
MB 701	Clinical Trials	2	0	0	2	2
MB 702	Forensic Biotechnology	2	0	2	4	3
MB 703	Metabolic Engineering and Systems Biology	3	0	2	5	4
MB 704	Seminars in Medical Biotechnology	2	0	0	2	2
MB 705/706	Elective III	3	1	0	4	4
BTSEC701 (Skill enhancement course)	NPTEL/SWAYAM/MOOC online course (Based on the courses offered on the MOOCs platform at that point of time)	2	0	0	2	2
BTAEC701 (Ability Enhancement Program)	Aptitude Building-VII (includes Competitive exam preparation, placement related sessions and alumni interactions and trainings)	0	0	2	2	1
	Total	**14**	**1**	**6**	**21**	**18**
Elective III : (Biomechatronics/ Epidemiology and Public Health)						

NAME OF THE COURSE: CLINICAL TRIALS

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

MARKS: 50 (Theory only) **2 0 0 2 2**

OBJECTIVES:

- To familiarize the student with the basic concepts of clinical trials
- To provide the knowledge for designing a clinical trial

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 701.1	Determine clinical trial terminology, ethical guidelines, and new drug development process
MB 701.2	Illustrate the study-design and recruitment process to initiate clinical trials
MB 701.3	Assess the impact of adverse effects and unbiased data management as per the GCP
MB 701.4	Comprehend the trial completion, implication, follow up and report generation procedures

PREREQUISITE:

Students should be familiar with biology and basic statistics to take up this course.

COURSE DESCRIPTION:

Unit	Topic	Detailed syllabus	No. of Lectures
1	Introduction to clinical trials and Ethical issues	History & background of origin of clinical research; Drug development process and phases of clinical trials (CT); Terminologies used in clinical research; Ethics in clinical research	4
2	Design of the study	Selection of questions; Defining study population; Type of study designs- randomized and nonrandomized control trials, Databases, Cross-over, Factorial, Group allocation, Hybrid design etc.	5
	Randomization and blinding	Types and mechanics of randomization; Types of blinding in trials and methods of protecting blind design; Bias control procedures; Stratification; Variance control	3
	Initializing recruitment	Sample size calculation and the importance of sample size; Recruitment of participants; Baseline assessment	4
3	Data management and analysis	Quality monitoring of the data; Minimizing poor quality data; Data analysis; competing events; co-variance adjustment; Subgroup analysis; Cut-points; Meta-analysis	4
	Impact analysis	Determination, analysis, and reporting adverse effect; Assessment of health-related quality of life; Adherence monitoring; Estimation and comparison of survival curves.	4

4	Close-out, reporting and interpretation of results	Termination of the trial; Procedure of termination, Post study follow up, Evaluation of the trial; Reporting a trial, interpretation and publication bias; Comparing results between studies; clinical implication of the Findings; Multicenter trials; Globalization of trials	6
Total Number of Lectures			**30**

METHODOLOGY:
The course will be covered through lectures and discussion of case studies.

EVALUATION SCHEME (THEORY):

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance		5
End Semester Exam	1 hour 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

REFERENCES:

1. Fundamentals of clinical trials, by Friedman, LM; Furberg, CD; Demets, DL; 2015. ISBN 978-1-4419-1585-6, Publisher Springer
2. Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D., & Newman, T. B. (2022). Designing clinical research (5th ed.). Wolters Kluwer.
3. Gallin J, Ognibene F, Johnson L.L. 2017. ISBN 978-0-1284-9905-4, Academic Press

Matrix for Program Outcome and Program Specific Outcome

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
MB 701.1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
MB 701.2	3	3	3	3	3	3	3	3	3	2	2	3	3	3	3
MB 701.3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
MB 701.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

NAME OF THE COURSE: FORENSIC BIOTECHNOLOGY

COURSE CODE: MB 702 **L T P Hr C**
MARKS: 100 (Theory 50 + Practical 50) **2 0 2 4 3**

OBJECTIVES:

- Introduce students to modern forensic science.
- Accredit students with various branches and wide reach of Forensics Science
- Equip students to perform basic forensic analysis.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 702.1	Comprehend the scope and evolution of forensic science
MB 702.2	Apply the knowledge of forensic techniques such forensic entomology, forensic anthropology and forensic blood stain analysis for investigation
MB 702.3	Demonstrate DNA fingerprinting and its analysis
MB 702.4	Formulate presumptive theory for forensic investigation by analyzing the evidence at a crime scene

PREREQUISITES:

Since the course is advance in nature, knowledge in biochemistry, genetics & molecular biology is essential to take the course.

COURSE DESCRIPTION:

Unit	Chapter	Detailed syllabus	No. of Lectures
1	Introduction	Scope of Forensics. History of Forensics - Locard's exchange principle. Services offered by Forensic Labs.	2
	Nature of Evidence	Types of evidence. Collecting evidence	4

2	Forensic Anthropology, Forensic Entomology, Forensic Odontology	Names of Major Human Bones, Identifying, understanding and collecting information about the crime scene using the Skeletal remains Understanding the relation between Insects and dead body Basic principle of Forensic Odontology, History of FO, Identification and Bite marks in theory.	6
	Forensics Pathology & Forensic Serology	Basics of Forensic Pathology - Algor Mortis, Rigor Mortis, Post mortem lividity, Decomposition. ABO blood types & their inheritance. Blood Spatter analysis.	5
3	Fingerprints	Introduction to Fingerprints, Fingerprint pattern, Collecting and matching fingerprint evidence.	3
	DNA analysis and DNA fingerprinting	Analysis of DNA using RFLP, RAPD. STR based DNA fingerprinting, Mitochondrial DNA analysis.	5
4	Drugs, Toxins and Alcohol	Abuse and effects of - Barbiturates, Opiates, Stimulants, Hallucinogens. Alcohol & it relationship to human anatomy & metabolism.	5
Total Number of Lectures			**30**

METHODOLOGY:

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

EVALUATION SCHEME (THEORY):

Examination	**Duration**	**Marks**
Internal*	45 minutes	15
Attendance	-	5
End Semester Exam	1hour 15 minutes	30
Total		**50**

*Average of Internal I (15 marks) and Internal II (15 marks)

PRACTICAL IN FORENSIC BIOTECHNOLOGY: (2 HOURS PER WEEK) MARKS: 50

1. Isolation of genomic DNA from body fluid/blood of different individuals and comparing the band pattern after restriction digestion.
2. To amplify the DNA from body sample using PCR
3. To identify Drug/Poison from individual body fluid by using TLC/ Immunological method
4. To study and detect the fingerprint using ninhydrin and compare fingerprints of two different individuals.
5. To Study hair sample of different origin/species under microscope.
6. To study and analyze the Blood stain pattern created from increasing height on various surface.
7. To determine the angle of blood and its point of origin.
8. To identify the blood using Kastle Meyer Test
9. Demirjian's age estimation technique

METHODOLOGY:

The course will be covered through practical work supported by field study.
They would be taught basic techniques in forensic science laboratory.

PRACTICAL EVALUATION SCHEME:

Examination	**Marks**
Continuous Assessment	20
End semester Examination	30
Total	**50**

REFERENCES:

1. The essentials of Forensic Medicine and Toxicology, by K S Narayan Reddy, 34th Edition 2017.
3. Fundamentals of Forensic DNA Typing, by John M. Butler, 2nd Edition, Publisher: Academic Press; ISBN-13: 978-0123749994, 2015.
4. Forensic Odontology, Principles & Practice by Taylor & Keiser, 1st Edition, Reprint 2016

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 702.1	1	3	2	3	3	2	2	2	3	2	0	3	2	1	-
MB 702.2	2	2	3	2	3	2	2	2	2	2	2	2	3	3	2
MB 702.3	3	1	2	2	3	2	1	1	2	2	3	2	3	3	3
MB 702.4	2	3	2	3	-	-	-	-	-	-	-	-	3	3	3

COURSE: METABOLIC ENGINEERING AND SYSTEMS BIOLOGY

COURSE CODE: MB 703 **L T P Hr C**

MARKS: 150 (Theory 100 + Practical 50) **3 0 2 5 4**

OBJECTIVES:

- The course will provide an overview of the basic concepts and experimental techniques used in metabolic engineering and its applications in production of useful compounds of industrial importance.
- The students will learn that how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism.
- The course will cover examples of successful engineering strategies used for the production of commercially important primary and secondary metabolites or recombinant proteins.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 703.1	Explain the basic concepts of metabolic engineering, cellular reactions, enzyme kinetics and their regulation
MB 703.2	Discuss strain-engineering strategies to alter cellular behaviour, metabolic flux and product formation
MB 703.3	Analyse the methods for metabolic flux determination
MB 703.4	Illustrate different pathways for the production and regulation of metabolites, and techniques for strain improvement
MB 703.5	Plan the application of pathway databases in metabolic engineering
MB 703.6	Demonstrate various system biology tools for determination of metabolic pathways

PREREQUISITES:

Students should be familiar with basic concepts of biochemistry, metabolism and bioinformatics.

COURSE DESCRIPTION:

Unit	Topics	Detailed syllabus	No. of Lectures
1	Introduction to metabolic engineering and its importance	Basic concepts of metabolic engineering. Key differences between metabolic controls of prokaryotes and eukaryotes. Stoichiometry of cellular reactions, enzyme kinetics, reaction rates, dynamic mass balance, yield coefficients and linear rate equations, the black box model, elementary balance, heat balance different models for cellular Reactions-Induction-Jacob Monod Model and its regulation, differential regulation by isoenzymes, concerted or cumulative feedback regulation.	10

		Regulation in branched pathways, permeability and transport of metabolites.	
2	Metabolic flux analysis	Building stoichiometric matrix; Steady state and pseudo steady state assumptions; Using different optimizing functions to solve linear programming problem; understanding flux cone and constraints; Introducing additional constraints from thermodynamics.	7
3	Experimental determination of metabolic fluxes	C13 labeling, NMR and GC-MS based methods for flux determination.	4
4	Industrial applications of metabolic engineering	Pathway engineering strategies for overproduction of some commercially important primary and secondary metabolites (e.g. amino acids, organic acids, alcohols and therapeutic compounds) or industrially relevant enzymes and recombinant proteins, bioconversion- applications and factors affecting bioconversion, regulation of enzyme production, strain selection and improvement, the modification of existing or the introduction of entirely new metabolic pathways.	6
5	Computational study of metabolic engineering	Role of Bioinformatics in the study of metabolic pathway such as for predicting and engineering metabolic pathways. Metabolic pathway databases and models (BioPath, BioSilico, KEGG, HUMANCyc, Model SEED, MouseCyc, Reactome). Metabolic pathway synthesis algorithms.	10
6	Introduction to Systems Biology	Introduction of the systems approach to biology, Definition of system and elements of systems biology, Modeling in systems biology, key properties of biological systems/ models, Systems level understanding of biological systems, High throughput screens in cellular systems, Introduction to network biology.	8
Total Number of Lectures			**45**

METHODOLOGY:
The course will be covered through lectures and supported by practical.

EVALUATION SCHEME (THEORY):

Examination	**Duration**	**Marks**
I Internal Exam	1 hour	20
II Internal Exam	45 minutes	15
Attendance		5
End Semester Exam	02 hours 30 minutes	60
Total		**100**

PRACTICAL IN METABOLIC ENGINEERING AND SYSTEMS BIOLOGY

(2 HOURS PER WEEK) MARKS: 50

List of experiments:

1. Expression of metabolic enzymes in bacterial systems for metabolite engineering.
2. Effect of different parameters such as substrate concentration on metabolite expression.
3. Isolation and purification of industrially relevant metabolic enzymes.
4. Validation of enzyme expression and its effect on metabolic changes.
5. Extraction of Genes from KEGG
6. Screening of pathways getting affected by administration of drugs
7. Generate interaction map using list of genes
8. Exploring Cytoscape for representing a network.
9. Finding Hub Genes

PRACTICAL EVALUATION SCHEME :

Examination	**Marks**
Practical Internal (Continuous) assessment:	20
End semester examination:	30
Total:	**50**

REFERENCES:

1. Synthetic Biology – Metabolic Engineering by Huimin Zhao, An-Ping Zeng, Springer 2018.
2. Metabolic Engineering for Bioactive Compounds: Strategies and Processes by Vipin Chandra Kalia, Adesh Kumar Saini, Springer 2017.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 703.1	3	2	3	-	-	-	-	-	2	3	-	2	3	2	1
MB 703.2	1	2	3	3	3	2	2	2	2	1	-	3	3	3	1
MB 703.3	2	2	3	3	3	2	2	2	2	2	-	3	3	3	1
MB 703.4	1	2	3	3	3	2	2	3	3	2	2	3	3	3	3
MB 703.5	3	3	3	3	3	2	1	1	2	2	1	2	1	1	3
MB 703.6	2	2	2	2	2	1	2	2	2	2	1	2	3	2	1

NAME OF THE COURSE: SEMINARS IN MEDICAL BIOTECHNOLOGY

COURSE CODE: MB 704	**L**	**T**	**P**	**Hr**	**C**
MARKS: 50	**2**	**0**	**0**	**2**	**2**

OBJECTIVES:

- To train the students for literature survey
- To understand and present a particular topic, published research work in front of an audience
- To develop capability and potential to discuss, delineate a topic precisely, professionally in an interactive manner

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 704.1	Examine specific topics that can provide insights into the most recent developments in medicine, food, agriculture and different areas of biotechnology
MB 704.2	Evaluate research information and appreciate how strategies are developed to address specific scientific questions
MB 704.3	Develop critical thinking and scientific temperament
MB 704.4	Demonstrate presentation skills, communication abilities, and confidence in sharing their work with a broader audience
MB 704.5	Examine different viewpoints and approaches in biotechnology to broaden knowledge horizons
MB 704.6	Acquire knowledge in developing ideas, projects based on their own research questions

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 707.1	2	3	-	-	-	-	-	3	2	3	-	2	2	3	3
BT 707.2	2	3	-	-	-	-	-	2	3	3	-	3	2	3	3
BT 707.3	3	2	3	-	-	-	-	2	2	2	-	2	2	2	2
BT 707.4	1	-	-	-	-	2	-	2	3	3	3	2	1	3	2
BT 707.5	2	3	-	-	-	-	-	-	3	3	-	3	1	2	2
BT 707.6	2	2	3	3	3	2	2	2	3	3	3	2	2	2	2

ELECTIVE III:
COURSE: BIOMECHATRONICS
COURSE CODE: MB 705 **L T P Hr C**
MARKS: 100 (Theory only) **3 1 0 4 4**

OBJECTIVES:

- Advance students' knowledge in the frontier and upcoming area of Biomechatronics.
- Familiarize students with the principles and applications of Biomechatronics in the medical field.
- Provide an understanding of Biosensor technology and its applications.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 705.1	Outline the fundamental principles governing integration of biological systems with mechanical and electronic counterparts
MB 705.2	Analyse interactions between elements of biomechatronics and get familiarized with materials, sensors, and actuators suitable for interfacing with biological systems
MB 705.3	Illustrate the structure, design, simulation, and prototype of basic biomechatronic devices and explain their control using physical intelligence and neural interface
MB 705.4	Discuss various bioinspired robotic techniques applied in biomechatronics
MB 705.5	Apply biomechatronics approach for designing different diagnostics devices
MB 705.6	Explain the concept of biosensors and its application in biomechatronics

PREREQUISITES:

Students should have studied basic Human Anatomy and Physiology, Artificial Organs and Biomimetics, Electronics, and Engineering Mechanics.

COURSE DESCRIPTION:

Unit	Topic	Detailed syllabus	No. of lectur
1	Introduction	Definition of Biomechatronic products, Applying mechatronic theory to Biotechnology; Kinematics and Dynamics, Introduction to Biomechatronic Design methods and tools.	5
2	Elements of Biomechatronics	Conventional actuators, Synthetic muscles, Electroactive polymers, Shape-memory alloys and Shape-memory polymers, Variable stiffness/Impedance actuators, Biological actuators (muscles), Natural sensors, Sensory receptors, Synthetic biological and non-biological sensors, Sensor fusion and integration, Systems for sensory feedback, Transducers and Signal processing.	8

3	Control, Physical Intelligence, Neural Interface	Physical intelligence, Control and artificial intelligence, Machine learning, Data mining, Biological Neural networks, Electrical Recording and stimulation, Optical recording and stimulation.	6
4	Artificial Support systems	Orthopaedic devices, neuromodulation, Advanced prosthetics, Powered orthotics, Exoskeletons, exomusculature, exosuits; Physical therapy and rehabilitation, Advanced wheelchairs, Assisted walking, Feeding and hygiene systems, Assistive robotic arms; Robotic Nurses, Robotic massage, Vocational aid; Biomechanics and Biomechatronics in sports & exercise.	8
	Highly specialized Biomechatronics	Molecular and cellular level, Micro- and nanorobots, Robotic surgery, Bioinspired Robotics (Bioinspiration; Bioinspired Locomotion, manipulation, Soft-robotics; Algorithmic bioinspiration).	6
5	Supplementary applica applying Biomechatro approach.	Blood glucose sensors, Surface Plasmon Resonance Biosensor Devices, Diagnostic Device for *Helicobacter pylori* Infection, Microarray devices, Cellular and Tissue Engineering Bioreactors, Stem Cell Manufacturing, Bioartificial Organ-Simulating Devices.	5
6	Biosensors	Principles in various biosensors, elements of biosensors; Types of biosensors based on biological recognition elements; Types of biosensors based on types of transducer; Applications of biosensors, characteristics of ideal biosensors; Introduction to biosensor instrument	7
Total Number of Lectures			**45**

METHODOLOGY:
The course will be taught through lectures, exercises, participative learning, videos and Tutorials.

EVALUATION SCHEME (THEORY):

Examination	**Duration**	**Marks**
I Internal	1 hour	20
II Internal	45 mins	15
Attendance	----	5
End Semester Exam	2 hours 30 mins	60
Total		**100**

REFERENCES:

1. Biomechatronics 1st Edition by Marko Popovic (Author), Academic Press 2019.
2. Handbook of Biomechatronics 1st Edition by Jacob Segil (Editor), Academic Press 2018.
3. Biomechatronics in Medical Rehabilitation-Biomodelling, Interface, and Control; Shane Xie, Wei Meng; 1st Edition, 2017; Publisher Springer; ISBN 978-3-319-52883-0

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 705.1	2	3	2	-	2	3	-	-	2	3	3	2	1	1	1
MB 705.2	2	3	3	2	2	3	2	3	2	2	**2**	1	2	2	2
MB 705.3	3	2	2	2	3	3	2	2	3	2	**2**	1	1	2	1
MB 705.4	3	2	3	3	2	3	2	2	2	3	2	2	3	2	2
MB 705.5	3	2	2	3	2	3	3	2	3	3	2	3	3	2	2
MB 705.6	1	2	2	3	2	3	2	2	3	3	2	2	2	2	2

NAME OF THE COURSE: EPIDEMIOLOGY AND PUBLIC HEALTH

COURSE CODE: MB 706	**L**	**T**	**P**	**Hr**	**C**
MARKS: 100 (Theory only)	**3**	**1**	**0**	**4**	**4**

OBJECTIVES:

- The discipline of public health, the science of disease prevention in populations
- The science of epidemiology, a key discipline of public health studies
- Recent strategies and measures used in addressing current public health issues

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
MB 706.1	Explain the discipline of public health and its history
MB 706.2	Illustrate epidemiological triad, risk factors/groups in public health and analyse mortality and morbidity in public health systems
MB 706.3	Comprehend global health databases, and epidemiological and demographic transition
MB 706.4	Describe aims, approaches and study designs in epidemiology
MB 706.5	Discuss ethical and regulatory guidelines for conducting public health studies
MB 706.6	Apply epidemiology for investigation and prevention of disease outbreaks, and outline implications on Indian health system

PREREQUISITES: Basic knowledge of communicable, non-communicable diseases, diagnostic procedures and biostatistics.

COURSE DESCRIPTION:

Unit	Topics	Detailed syllabus	No. of Lectures
1	The discipline of public health and its history	The science and practice of public health, Origin of the field of public health, Distinction between medicine and public health	3
2	Health and disease	Concept of health, WHO definition, Disease causation models, Epidemiological triad, Natural history of disease, Risk factors, Risk groups	4
	Population-level disease measures	Measurement of morbidity and mortality: Incidence, Prevalence, Age adjustment	4

3	Global and Indian health data	Sources of data, Global health databases, Sources of health data in India	3
	Global health and Health transition	Global Health status, Epidemiological transition, Demographic Transition, Health indicators of India	4
4	The science of epidemiology	Aims, approaches and its applications.	3
	Epidemiological study designs	Descriptive studies [cross-sectional, case control, cohort] and Analytical studies [randomized controlled trials or RCT] Predictive value of diagnostics (Test validity: sensitivity, specificity, positive predictive value and negative predictive value of a screening and diagnostic test)	6
5	Ethical and regulatory issues in conducting human studies	Ethics: History, Nuremberg code, Helsinki declaration, ICMR guidelines, New Drug Regulation Rules 2019, IBSC, DBT-ICMR guidelines on Stem Cell Research	2
6	Applications of epidemiology I :Prevention of diseases	Primary (specific protection eg. vaccines, health promotion eg. public health messaging), secondary (screening and early case detection) and tertiary prevention (disability limitation through appropriate medical and other services)	6
	Applications of epidemiology II : Investigation of disease outbreaks	Definitions, Epidemic curves, Steps in investigation, Endemic, Epidemic, Pandemic Herd Immunity and Ro, Case studies – the SARS-Cov-2 pandemic	8
	Public Health System	Organization of the Indian health system and its implications	2
Total Number of Lectures Total			**45**

METHODOLOGY:
The course will be covered through lectures and case studies.

EVALUATION SCHEME (THEORY):

Examination	Duration	Marks
I Internal	1 hour	20
II Internal	45 mins	15
Attendance	----	5
End Semester Exam	2 hours 30 mins	60
Total		**100**

BOOKS RECOMMENDED:

1. Gordis Epidemiology 6th Edition, 2019, Celentano David D. and Szklo M.M , ISBN: 978-0-323-55229-5, Publisher: Elsevier
2. Park's Textbook of Preventive and Social Medicine 25th Edition 2019, K. Park,, ISBN: 9780195647068, 9780195647068, Publisher : Bhanot publishing House
3. Public Health and Epidemiology at a Glance, 2nd Edition, 2016, Margaret Somerville, K. Kumaran, Rob Anderson, ISBN: 978-1-118-99932-5, Publisher: WileyBlackwell

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MB 706.1	2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
MB 706.2	1	3	3	2	2	1	3	3	1	3	3	3	-	-	1
MB 706.3	1	2	3	2	3	3	2	3	3	3	2	3	-	-	2
MB 706.4	2	2	2	3	2	3	3	3	2	2	2	1	-	-	2
MB 706.5	1	2	3	2	3	3	3	3	2	3	2	2	-	-	3
MB 706.6	1	3	2	3	2	3	3	3	2	2	3	3	-	1	2

COURSE: NPTEL/SWAYAM/MOOC ONLINE COURSE

COURSE CODE: BTSEC301	**L**	**T**	**P**	**Hr**	**C**
MARKS: 50 (Theory only)	**2**	**0**	**0**	**2**	**2**

OBJECTIVE

Enhancement of student's skill by giving them the opportunity to gain insight on a topic of interest which is not a part of the syllabus.

DESCRIPTION:

The list of courses offered on the MOOCs platform during the third semester are provided to the students. The list includes core program specific courses, soft skill development courses and other additional skill development courses, the duration of which is 8 weeks. The students choose any one of the course which interests them the most. At the end of the semester the students need to earn a certificate on the basis of which they will be given credits out of two.

COURSE: APTITUDE BUILDING-VII

COURSE CODE: BTAEC701 **L T P Hr C**

MARKS: 50 (Practical only) **0 0 2 2 1**

OBJECTIVES:

- Brush up of all the concepts of Aptitude & Life Skills
- Give students the confidence for their placements & future career opportunities

COURSE OUTCOME:

CO No.	At the end of the course, the learner should be able to:
BTAEC601.1	Acquire a knowledge of solving quantitative aptitude, reasoning and verbal ability questions effortlessly.
BTAEC601.2	Develop demonstrable hard skills
BTAEC601.3	Perceive noticeable soft skills
BTAEC601.4	Develop technical skills

PREREQUISITE:

Students should be familiar with basic scientific concepts to take up this course.

COURSE DESCRIPTION

Sr. No.	Practical/Training/Tests/Interviews	Contact Hours
1	Industry specific-Aptitude and Life Skills	18
2	Biosensors	02
3	Practice Tests	04
4	Competitive Examination Preparation	02
5	Mock Interviews	02
6	Discussion session-Industry Experts/Academia Experts/Alumni	02
	Total Practical/Training Hours	**30**

METHODOLOGY

The course will be covered through Lectures/Assignments/Practical/Training/Tests/Interviews

EVALUATION SCHEME (THEORY)

Examination	Duration	Marks
Continuous Internal Assessment		20
Attendance		

Assignments/Practical/Training/Tests/Interviews	30
Total	**50**

REFERENCES:

1. R. S. Aggarwal, (2017). Quantitative Aptitude for Competitive Examinations, 3rd (Ed.). New Delhi: S. Chand Publishing
2. ETHNUS, (2016). Aptimithra, 1st (Ed.). Bangalore: McGraw-Hill Education Pvt. Ltd.
3. Arun Sharma, (2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTAEC601.1	-	3	3	2	3	1	-	1	-	2	2	3	3	-	-
BTAEC601.2	2	2	2	-	-	1	-	1	-	2	-	2	2	-	1
BTAEC601.3	2	2	2	-	3	1	-	1	-	3	-	2	2	-	-
BTAEC601.4	2	2	2	-	2	1	-	1	-	2	-	2	2	2	-

Semester VIII	
MB 801: Research Project/ Industrial Training/ Review writing (5 months)	**22 Credits**

OBJECTIVES:

- Train the students to understand the research environment in a laboratory/ Industrial training and culture
- Enable students to learn practical aspects of research
- Impart training to the students for Literature review, Review writing, data analysis and thesis writing.

COURSE OUTCOMES:

CO No.	At the end of the course, the learner should be able to:
BT P801.1	Acquire in-depth knowledge of the chosen area of research
BT P801.2	Identify research gap, frame hypothesis/objectives and develop competence in research design and planning
BT P801.3	Perform analytical techniques/experimental methods to obtain objective-oriented results
BT P801.4	Acquire research report writing and publication skills

Matrix for Program Outcome and Program Specific Outcome

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT 801.1	2	3	3	2	3	2	3	2	2	2	2	3	3	3	3
BT 801.2	3	3	2	3	3	2	2	3	2	2	2	2	2	3	2
BT 801.3	3	2	3	3	3	2	1	1	2	1	3	2	2	2	3
BT 801.4	1	2	2	2	2	3	3	2	2	3	2	3	3	2	2