Three-Year Diploma Programme

Diploma in

Biotechnology

Curriculum 2024 - 2025

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

1. Vision of the Department

To inculcate academic excellence in the field of biotechnology by creating skilled biotechnology professionals who can revolutionize, discover, design & formulate valuable biological products & solutions for the welfare of the society & environment.

2. Mission of the Department

M1 To develop young enthusiastic biotechnologists who can work in the bio-industry or multidisciplinary areas & contribute to the progress of the nation through research and development.

M2 To build ethically strong biotechnologists who have moral responsibilities towards the growth of the nation.

M3 To impart the knowledge among students at par the need of the biotechnology industries and undertake collaborative research challenges which provides long term relation between academia & industry.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the Diploma Biotechnology curriculum enables graduates to attain.

PEO 1	To inculcate successful biotechnology engineers with technical and professional skills to sustain a career in the biotechnology industry.
PEO 2	To endorse biotechnology engineers with strong fundamental and professional knowledge for the lifelong learning in terms of higher education and research.
PEO 3	To train biotechnology engineering professionals with good leadership quality and interpersonal skills to design, analyze and solve the technical problems for bio-industry.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of Study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 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 public health and safety, and cultural, societal, and environmental considerations.
PLO 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.
PLO 5	**Modern tool usage:**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 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.
PLO 7	**Environment and sustainability:**	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 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.
PLO 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.
PLO 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.

5. Program Specific Learning Outcomes

PSLO 1	To impart an ability to apply fundamental knowledge of biotechnology and engineering skills to solve problems in the biotechnology industry and research organizations.
PSLO 2	To provide students with research-based knowledge of the core and allied field for experimental design, various biological data analyses, and interpretation to fruitful developments in the biotechnology industries and research centers.
PSLO 3	To impart an ability to work with diverse groups or individuals with strong moral values to enhance entrepreneurship, communication, and management skills for the next generation of biotechnologists.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	19
Semester-2	23
Semester-3	19
Semester-4	20
Semester-5	24
Semester-6	22
Total Credits:	**127**

Category wise Credit distribution of the programme	
Category	**Credit**
Major Core	78
Minor Stream	6
Multidisciplinary	22
Ability Enhancement Course	3
Skill Enhancement Courses	4
Value added Courses	0
Summer Internship	2
Research Project/Dissertation	12
Total Credits:	**127**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03602107	Applied Chemistry	3	3	-	-
2	03602108	Applied Chemistry Lab	1	-	2	-
3	03605101	Environmental Science	Audit Course	2	-	-
4	03606102	Introduction to IT Systems Lab	2	-	4	-
5	03630102	Introduction to Biotechnology	2	2	0	0
6	03630103	Fluid Mechanics	2	2	0	0
7	03630104	Fluid Mechanics Lab	1	0	2	0
8	03691101	Mathematics - I	3	2	-	1
9	03692154	Basic Physics Lab	1	-	2	-
10	03692155	Basic Physics	3	3	-	-
11	03693103	Communication Skills - I	1	1	-	-
Total			**19**	**15**	**10**	**1**

Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
12	03602151	Organic Chemistry	4	4	-	-
13	03602152	Organic Chemistry lab	1	-	2	-
14	03609154	Engineering Workshop Practice	2	-	4	-
15	03630152	Molecular Biology	3	3	0	0
16	03630153	Basic of Chemical Engineering Thermodynamics	3	3	0	0
17	03630156	Basics of Immunology	2	2	0	0
18	03630159	Fundamentals of Microbiology	2	2	0	0
19	03630160	Fundamentals of Microbiology Lab	1	0	2	0
20	03691151	Mathematics-II	4	3	-	1
21	03693153	Communication Skills -II	1	2	-	-

Total			**23**	**19**	**8**	**1**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
22	03600201	Entrepreneurship and Start-ups	1	1	-	-
23	03630201	Life science-I	4	4	0	0
24	03630206	Biochemical Calculations	4	4	0	0
25	03630207	Bioenergetics	4	4	0	0
26	03630209	Bioprocess Engineering	4	4	0	0
27	03630210	Bioprocess Engineering Lab	1	0	2	0
28	03693203	Professional Communication and Critical Thinking	1	1	-	-
		Total	**19**	**18**	**2**	**0**
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
29	03600251	Essence of Indian Knowledge and Tradition	0	2	-	-
30	03630251	Cell Biology	3	3	0	0
31	03630253	Analytical Instruments for Biotechnology	3	3	0	0
32	03630254	Analytical Instruments for Biotechnology Lab	1	0	2	0
33	03630255	Fundamentals of Process Engineering	3	3	0	0
34	03630257	Basics of Food Processing	3	3	0	0
35	03630258	Basics of Food Processing Lab	1	0	2	0
36	03630259	Life Science-II	4	4	0	0
37	03630262	Minor Project	1	0	2	0
38	03693251	Employability Skills	1	1	-	-
Total			**20**	**19**	**6**	**0**
Semester 5						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
39	03630301	Biochemistry	4	4	0	0

40	03630302	Biochemistry Lab	1	0	2	0
41	03630303	Bioinformatics	4	4	0	0
42	03630304	Bioinformatics Lab	1	0	2	0
43	03630305	Environmental Biotechnology	3	3	0	0
44	03630307	Bioethics, IPR and Biosafety	3	3	0	0
45	03630309	Major Project-I	6	0	12	0
46	03630310	Summer Internship (2 Week After Sem - 4)	2	0	0	0
Total			**24**	**14**	**16**	**0**

Semester 6						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
47	03600351	Indian Constitution	0	2	-	-
48	03630351	Plant Tissue Culture	4	4	0	0
49	03630352	Plant Tissue Culture Lab	1	0	2	0
50	03630353	Genetic Engineering	4	4	0	0
51	03630354	Genetic Engineering Lab	1	0	2	0
52	03630356	Major Project-II	6	0	12	0
53		Program Elective - I (Compulsory Subjects :1)	3	3	0	0
54		Program Elective - II (Compulsory Subjects :1)	3	3	0	0
Total			**22**	**16**	**16**	**0**

Program Elective - I						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03630381	Metabolic Engineering	3	3	0	0
2	03630383	Entrepreneurship in Biotechnology	3	3	0	0

Program Elective - II						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	03630385	Biomaterials and Implants	3	3	0	0
2	03630387	Genomics and Proteomics	3	3	0	0

Detailed Syllabus

Semester 1

a) Course Name: Applied Chemistry

b) Course Code: 0362107

c) Prerequisite: Understanding of Basic knowledge of science for the application.

d) Rationale: The study of basic concepts of chemistry which will help the students understanding engineering subjects.

e) Course Learning Objective:

CLOBJ 1	Evaluate the chemical properties and performance of various fuels, including fossil fuels and alternative energy sources. Understand the environmental and economic implications of fuel use.
CLOBJ 2	Relate the chemical principles behind adhesive formulations and their applications. Analyze factors affecting adhesive strength and durability.
CLOBJ 3	Demonstrate a comprehensive understanding of electrochemical concepts, including redox reactions, electrochemical cells, and applications in energy storage and conversion technologies.
CLOBJ 4	Explain the types and nature of chemical bonds (ionic, covalent, metallic) and their effects on the physical and chemical properties of materials. Apply this knowledge to predict molecular behavior and interactions.

f) Course Learning Outcomes:

CLO 1	Summarize the concept of Existence of material in nature.
CLO 2	Plan with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**		**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**

1	**Unit – I Chemical Bonding and Catalysis** Rutherford model of atom, Bohr's theory, Heisenberg uncertainty principle, Quantum numbers – orbital concept. 2. Shapes of sap and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration, Theory Of Valency , Electronic Configuration , Types of chemical bonds - Electrovalent bond, & its characteristics ,Covalent bond & its characteristics ,Co-ordinate bond , Hydrogen bond, its types and Significance , Metallic bond, Explanation of Metallic properties, Electron Sea Model , Intermolecular force of attraction ,Vander Waals force of attraction ,Catalysis, Types of catalysis , Theory of Catalysis , Characteristics of Catalyst , Types of Catalyst , Positive Catalyst ,Negative Catalyst , Auto-catalyst Catalytic Promoter and Catalytic inhibitor Industrial Application of Catalyst.	**10**	**6**
2	**Unit– II Concepts of Electrochemistry** Introduction, Arrhenius theory of ionization., Degree of ionization, Factors affecting the degree of ionization, Definition of pH, pH of acid, base and neutral solution, pH calculations of acid, base and salt solution at different concentration, Importance of pH in various fields, Definition of buffer solution, Buffer Action & Types of buffer Solution, Application of buffer solutions, Electrolytes and Non-electrolytes, Types of electrolytes Definition the term ` Electrode ' the Types of Electrodes Inert electrode, Working electrode & Reference electrode; with suitable Illustrations. Construction & working of reference electrode, Hydrogen electrode, Calomel electrode, Quinhydrone electrode, Glass electrode, Ag/ Agcl/ Kcl electrode • Kohlrausch Law of independent, Migration of ions, Construction and working of electrochemical cell, Standard conditions, Standard hydrogen electrodes, Nernst theory of single electrode potential & Nernst equation, Electrochemical series, galvanic series, Electrolysis, Faradays laws of electrolysis, Industrial application of Electrolysis,	**20**	**8**
3	**Unit– III Corrosion of metals & its prevention** Definition of corrosion, Types of corrosion, Dry corrosion: Oxidation corrosion mechanism corrosion-mechanism, Nature of oxide film, Wet corrosion-mechanism, Concentration cell corrosion, Pitting corrosion, Waterline corrosion, Crevice corrosion, Stress Corrosion, Erosion Corrosion, Factors affecting the rate of corrosion, - Nature of film, Nature of Environment of Solution, Area of cathode anode and, Temperature, Moisture, Purity of metal, Methods of prevention of corrosion, Modification of environment, Modification of the properties of metal, Use of protective coatings., Anodic and cathodic protection, Modification in design and choice of material	**10**	**5**

4	**Unit– IV Water Treatment** Graphical presentation of water distribution on Earth (pie or bar diagram). Hard water and soft water. Types of hardness of water, Salts producing hardness of water, Method to express the hardness of water, Estimation of total hardness by EDTA Method, Examples to calculate the hardness, Effect of hard water in Boiler operation I. Scale and sludge formation and its Prevention, Priming and foaming and its prevention, Caustic embrittlement and its prevention. Corrosion and its prevention, Softening of Water, Soda-Lime process, Permuted process, Ion Exchange process, Reverse Osmosis process, Treatment of Drinking water, Sedimentation, Coagulation, Filtration, Sterilization of water by chlorination Break-point chlorination-Graph., enlist Indian standard specification of drinking water	**20**	**8**
5	**Unit– V Lubricants** ntroduction and definition of lubricants and lubrication, function of lubricants, Types of lubrication, Fluid film lubrication, Boundary lubrication, Classification of lubricants, Solid lubricants, Semi-solid lubricants, Liquid lubricants, Synthetic oils, Physical Properties of lubricants and their significance like. Viscosity and viscosity index, Flash point and fire point, Pour point and cloud point, oiliness Chemical Properties of lubricants like I. Saponification value ii. Neutralization number iii. Emulsification number, Selection of lubricants for, Gears, Cutting tools, Steam turbine.	**10**	**5**
6	**Unit– VI Polymer, Elastomers & Adhesives** Introduction and Definition of Polymer and Monomer, Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers, Classification on basis of monomers (photopolymer and copolymer) Classification of Polymers on basis of Thermal behavior	**20**	**7**
	(Thermoplastics& Thermosetting), Types polymerization Reaction, Addition Polymerization, Condensation Polymerization, Synthesis, properties and application of I. Polyethylene, Polypropylene iii. Polyvinyl chloride iv. Teflon v. Polystyrene vi. Phenol formaldehyde vii. Acrylonitrile viii. Epoxy Resin, Define the term: - elastomer Natural rubber and its properties 5. Vulcanization of rubber 6. Synthetic rubber, Synthesis, properties and uses, Buna-S Rubber ii. Buna-N Rubber, Neoprene Rubber, Definition of adhesives and Examples, Characteristics of adhesives Classification of adhesives and their uses.		

7	**Unit-VII Chemistry of Fuel.** Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), Bomb Calorimeter, calculation of HCV and LCV using Delong's formula, Proximate analysis of coal, solid fuel petrol and diesel - fuel rating (octane and Cetane numbers), Chemical composition, calorific values and, applications of LPG, CNG, water gas, coal gas, producer gas and biogas.	**10**	**6**
	Total	**100**	**45**

i) Text Book and Reference Book:

1. A Text Book of Polytechnic Chemistry by V.P. Mehta | Jain Brothers
2. A Text Book of Applied Chemistry by J. Raja ram
3. ENGINEERING CHEMISTRY By B. SIVSANKAR | TATA MACGRAWHILL
4. Engineering Chemistry by Shashi Chawla | Dhanpati Rai and Co.

a) Course Name: Applied Chemistry Lab

b) Course Code: 03602108

c) Prerequisite: Understanding of Basic knowledge of science for the application.

d) Rationale: The course aims to equip students with practical skills in applied chemistry domain.

e) Course Learning Objective:

CLOBJ 1	Demonstrate a comprehensive understanding of electrochemical concepts, including redox reactions, electrochemical cells, and applications in energy storage and conversion technologies.
CLOBJ 2	Rephrase the impact of corrosion on materials and structures, and evaluate strategies for mitigation.
CLOBJ 3	Analyze the chemical processes involved in water treatment, including purification, disinfection, and waste water management. Understand the role of chemistry in ensuring safe and clean water supplies
CLOBJ 4	Describe the synthesis, properties, and applications of various polymers. Understand the relationship between polymer structure and performance, including aspects of polymerization techniques and material characteristics.
CLOBJ 5	Assess the chemical composition and performance of different lubricants. Understand their role in reducing friction and wear in mechanical systems, and analyze their environmental and economic impacts.

f) Course Learning Outcomes:

CLO 1	Compare the concept of Existence of material in nature.
CLO 2	Match with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.
CLO 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Experiment List:

Exp. No.	**Name of the Experiment**
1	Determine the strength of given acidic solution using standard solution of base.
2	Standardize KMnO4 solution by preparing standard oxalic acid and to estimate ferrous ions.

3	Standardize Na2S2O3 solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.
4	Determine the viscosity of given lubricating oil by using Red-wood Viscometer.
5	Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter.
6	To Determine molecular weight of a polymer using Ostwald viscometer.
7	Preparation of (any one) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterization.
8	To Determine Acid Value of given lubricating Oil.
9	Determine of the percentage of moisture in a given sample of coal by proximate analysis.
10	To Determine of saponification value of a lubricating oil.
11	Study of corrosion of metals in medium of different ph.
12	To Determine the COD of given water sample.
13	Determine Flash & Fire point of given lubricating oil.
14	Study of Corrosion of Metals in the different Mediums.

i) Text Book and Reference Book:

1. A Text Book of Polytechnic Chemistry by V.P. Mehta | Jain Brothers
2. A Text Book of Applied Chemistry by J. Raja ram
3. ENGINEERING CHEMISTRY By B. SIVSANKAR | TATA MACGRAWHILL
4. Engineering Chemistry by Shashi Chawla | Dhanpati Rai and Co.

a) **Course Name:** Environmental Science

b) **Course Code:** 03605101

c) **Prerequisite:** Understanding of subjects like biology, chemistry, physics, and earth science.

d) **Rationale:** The course is designed to equip students with knowledge on different aspects of environment and pollution related issues.

e) **Course Learning Objective:**

CLOBJ 1	Develop a strong foundation in ecological principles, including ecosystem dynamics, biodiversity, energy flow, and biogeochemical cycles.
CLOBJ 2	Construct and propose sustainable practices in areas such as energy consumption, waste management, water conservation, and resource use.
CLOBJ 3	Gain practical experience in fieldwork, including sample collection, environmental monitoring, and laboratory techniques for analyzing environmental data.
CLOBJ 4	Organize the science behind climate change, including greenhouse gas emissions, global warming, and the role of natural and human-induced factors in changing the Earth's climate.

f) **Course Learning Outcomes:**

CLO 1	Classify the ecosystem and terminology and solve various engineering problems Applying
CLO2	Ecosystem knowledge to produce eco – friendly products.
CLO 3	Infer the suitable air, the extent of noise pollution, and control measures and acts.
CLO 4	Utilize the water and soil pollution, and control measures and acts.
CLO 5	Simplify different renewable energy resources and efficient process of harvesting.
CLO 6	Makeup solid Waste Management, ISO 14000 & Environmental Management.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**20**	**20**	**-**	**-**	**-**	**40**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Ecosystem** Structure of ecosystem, Biotic & Abiotic components, Food chain and food web Carbon, Nitrogen, Sulphur, Phosphorus cycle. Global warming -Causes, effects, process, Green House Effect, Ozone depletion.	**15**	**4**

2	**Air and Noise Pollution** Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler). Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator). Gaseous Pollution Control: Absorber, Catalytic Converter, And Effects of air pollution due to Refrigerants, I.C., Boiler, Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000.	**22**	**6**
3	**Water and Soil Pollution** Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation. Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis), Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.	**24**	**8**
4	**Renewable Sources of energy** Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills. Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas. Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy.	**24**	**8**
5	**Solid Waste management** Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste. Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste.	**15**	**4**
	Total	**100**	**30**

i) Text Book and Reference Book:

1. **Principles of Solar Engineering**
   By Yogi Goswami D., Frank Keith, Jan F. Kreider | Taylor & Francis, 2003 | Second
2. **Environmental Studies**
   By M.P. Paonia, S.C. Sharma | Khanna Publishing House, New Delhi | 2017
3. **Renewable Energy Sources**
   By Twaddell J.W. and Weir. A | EFN Spon Ltd
4. **Environmental Sciences**
   By Daniel B Botkin & Edward A Keller, | John Wiley & Sons
5. **Air Pollution**
   By M. N. Rao and H. V. N. Rao | Tata McGraw-Hill Publishing Company
6. **Environmental Pollution Control Engineering**
   By Rao C.S | 2nd edition

a) **Course Name:** Introduction to IT Systems Lab

b) **Course Code:** 03606102

c) **Prerequisite:** Basic understanding of how to use Windows, Linux, or macOS, including file management, command line usage, and basic system settings.

d) **Rationale:** This course aims to teach students basics of computer including hardware and software.

e) **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to install, configure, and navigate different operating systems (Windows, Linux, etc.), understanding their core functions and interfaces.
CLOBJ 2	Execute tasks such as system booting, user account management, file permissions, and basic troubleshooting using command-line tools and graphical interfaces.
CLOBJ 3	Identify common IT system issues, such as hardware malfunctions, software conflicts, and network outages, and apply appropriate troubleshooting methods to resolve them.
CLOBJ 4	Survey system performance metrics such as CPU usage, memory utilization, and network traffic, and generate reports that document findings and suggest improvements.

f) **Course Learning Outcomes:**

CLO 1	Take part in the ecosystem and terminology and solve various engineering problems applying
CLO 2	Mark excels sheet, power point, word, access database etc.
CLO 3	Adapt internet effectively
CLO 4	Function dynamic webpages including style sheet
CLO 5	Comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, Create excel sheet, power point, word, access database etc.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1.	**Study practical of computer components** Study practical of computer components
2.	**Study practical of different OS installation (Windows, Linux, Ubuntu)** Study practical of different OS installation (Windows, Linux, Ubuntu)
3.	**Write a script for basic OS commands** Write a script for basic OS commands
4.	**Write a script for basic operators in OS** Write a script for basic operators in OS

5.	**Study practical of Internal structure and components of storage devices (Hard disk components)** Study practical of Internal structure and components of storage devices (Hard disk components)
6.	**Study practical of input working devices (Keyboard, Mouse, scanner)** Study practical of input working devices (Keyboard, Mouse, scanner)
7.	**Study practical of output working devices (Monitor, Printer)** Study practical of output working devices (Monitor, Printer)
8.	**Write a HTML code to display "hello world"** Write a HTML code to display "hello world"
9.	**Write a HTML code to create a table for student marksheet.** Write a HTML code to create a table for student marksheet.
10.	**Write a HTML code to create a simple registration form** Write a HTML code to create a simple registration form
11.	**Write a CSS to create user define tag** Write a CSS to create user define tag
12.	**Write an HTML code to create static website using CSS** Write an HTML code to create static website using CSS
13.	**Study practical of evolution and working of internet** Study practical of evolution and working of internet
14.	**Study practical of surfing techniques in internet** Study practical of surfing techniques in internet
15.	**Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.** Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.
16.	**Perform various DOS commands** Perform various DOS commands
17.	**Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis 1) Fetch the data of the student who has distinction 2) Fetch the data of students with minimum marks in each subject. 3) Sort the data based on percentage** Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis Fetch the data of the student who has distinction Fetch the data of students with minimum marks in each subject. Sort the data based on percentage
18.	**Create a presentation of your favorite movie using animation** Create a presentation of your favorite movie using animation
19.	**Create a word file for your resume** Create a word file for your resume
20.	**Create library management database in access with minimum 5 tables in it.** Create library management database in access with minimum 5 tables in it.

i) Text Book and Reference Book:

1. **Basic Computer Course Made Simple**
   By Satish Jain | BPB Publication
2. **Basic Computer Engineering**
   By Sanjay SilkAir and Rajesh K Shukla | Wiley India Pvt. Limited, Pub. Year 2011
3. **Computer Fundamentals**
   By P.K. Sinha | BPB Publications
4. **HTML & CSS: The Complete Reference**
   By Thomas A. Powell | McGraw Hill

a) Course Name: Introduction to Biotechnology

b) Course Code: 03630102

c) Prerequisite: Basic idea about biology.

d) Rationale: The aim of the course is to teach the students about emergence and basic concepts of biotechnology.

e) Course Learning Objective:

CLOBJ 1	Identify and describe the key milestones in the evolution of biology and their impact on the development of biotechnology.
CLOBJ 2	Analyze the relationship between core biological principles and their application in various biotechnological advancements.
CLOBJ 3	Evaluate the scope of biotechnology across diverse fields, including healthcare, agriculture, and environmental sustainability.
CLOBJ 4	Develop strategies to address societal challenges by applying biotechnological knowledge and techniques effectively.

f) Course Learning Outcomes:

CLO 1	Define and study evolution of biology.
CLO 2	Explain different aspects from biology to biotechnology.
CLO 3	Discuss scope of biotechnology.
CLO 4	Apply knowledge in biotechnology to solve societal problems.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	2	20	20		60	-	100

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE**- End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Emergence of Biology** Historical milestones, Use and Misuse of Biology, Careers in Biology, Unified and Basics Characteristics of Organisms, Analyzing the Living Things, The Energy Transfer Devices of Life, Metabolism is the total of all chemical reactions, Homeostasis, Growth, Development and Reproduction, Adaptation, death, challenges in human health.	20	6
2	**From Biology to Biotechnology** Definition, history, stages for development and establishment, Biotechnology period and policy, Biotechnological processes and products developed in the ancient period, classical Biotechnology and modern Biotechnology	25	8

3	**Scope and Importance to Biotechnology** Introduction to various branches of Biotechnology: Genetic Engineering/ Recombinant DNA technology, Plant Biotechnology, Animal Biotechnology, Medical Biotechnology, Industrial Biotechnology, Bioprocess Engineering, Food Biotechnology, Environment Biotechnology, Bioinformatics.	**35**	**10**
4	**Recent advances in Biotechnology** Modern tools and techniques used in biotechnology and their applications, Societal Interventions, Publications, Patenting, Start-ups, Risks and ethics.	**20**	**6**
	Total	**100**	**30**

i) Text Book and Reference Book:

1. Biology (TextBook)
Textbook for class XI, NCERT
2. Biology
By Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer
McGraw Hill Publication

a) Course Name: Mathematics – I

b) Course Code: 03691101

c) Prerequisite: Knowledge of basic concept studied till 10th std.

d) Rationale: The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics.

e) Course Learning Objective:

CLOBJ 1	Develop a strong foundation in essential mathematical concepts, including algebra, calculus, geometry, trigonometry, and statistics, to solve real-world and theoretical problems.
CLOBJ 2	Suppose accurate and efficient computations, both manually and using mathematical software tools, to solve algebraic equations, differential equations, and integrals.
CLOBJ 3	Prove mathematical ideas clearly and effectively in both written and oral forms, using appropriate notation, language, and logical structure to communicate solutions and reasoning.

f) Course Learning Outcomes:

CLO 1	Resolve Rational Fraction into sum of Partial Fractions in engineering problems.
CLO2	Omit Trigonometric Ratios and solve problems using the formulae for Multiple and Sub multiple Angles.
CLO 3	Represent Complex numbers in various forms like modulus-amplitude (polar) form, Exponential (Euler) form – illustrate with examples.
CLO 4	Choose the concepts of Limit and Continuity for solving the problems
CLO 5	Appreciate Differentiation and its meaning in engineering situations.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**1**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**UNIT I LOGARITHM** Definition, Logarithm as a transformation, Antilogarithm, Rules of Logarithms and examples, use logarithmic functions for simplifying arithmetic computations. Partial fractions: Definition of partial fractions. Types of partial fraction (Denominator	**17**	**4**

	containing non-repeated linear factors, repeated linear factors and irreducible non- repeated quadratic factors).		
2	**UNIT II Trigonometry** Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Trigonometric identities, Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of all trigonometric functions	**23**	**7**
3	**Unit III Complex Numbers** Definition of a complex number, real and imaginary parts of a complex number, Polar and Cartesian representation of complex number, Conjugate of complex number, Geometric representation of complex numbers and their operations, Modules and Amplitude form, De Moivre's Theorem, Root of Complex Number, Use of De Moivre's Theorem to simplify mathematical Expressions	**17**	**4**
4	**Unit IV: Function and Limit** Function and Limit Definition and concept of function, Concept of limits and standard forms of limits (limit of (an - an / x - a) when x tends to a, limit of (six / x) when x tends to 0, limit of (ax - 1 / x) when x tends to a, limit of (1 + x) 1/x when x tends to a)	**9**	**3**
5	**Unit V: Calculus** Differentiation: Definition of derivative, differentiation of standard function by first principle, Rule of Differentiation, Differentiation of algebraic, trigonometric, Exponential, Logarithmic, Implicit functions and Composite functions, Higher order derivatives.	**34**	**10**
	Total	**100**	**45**

i) Text Book and Reference Book:

1. **Advanced Mathematics for Polytechnic**
   By Pandya N R | Macmillan Publishers India Ltd.,2012
2. **A textbook of Engineering Mathematics by N.P. Bali, Laxmi Publication.**

a) Course Name: Communication Skills – I

b) Course Code: 03693103

c) Prerequisite: Knowledge of English Language.

d) Rationale: Communication confidence laced with knowledge of English grammar is essential for all engineers

e) Course Learning Objective:

CLOBJ 1	Encourage students to analyze information, evaluate arguments, and develop reasoned conclusions.
CLOBJ 2	Foster the ability to identify and solve complex problems through logical reasoning and creativity.
CLOBJ 3	Develop effective written, verbal, and non-verbal communication skills to express ideas clearly and persuasively.
CLOBJ 4	Teach students to work effectively in teams, valuing diverse perspectives and contributing positively to group efforts.
CLOBJ 5	Cultivate imaginative thinking and the ability to generate original ideas and solutions.

f) Course Learning Outcomes:

CLO 1	Analyze complex issues, evaluate evidence, and develop reasoned arguments to support their conclusions.
CLO 2	Identify problems, explore potential solutions, and implement strategies to address challenges effectively.
CLO 3	Articulate ideas clearly and persuasively in written, verbal, and non-verbal forms, adapting their communication style to different audiences and purposes.
CLO 4	Locate and critically evaluate information from various sources, demonstrating information literacy skills to support their learning and decision-making.
CLO 5	Create coherent and persuasive written and oral messages.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**		**100**	**-**	**-**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching Hours
1	**IceBreaker + Introducing your Friend** This is one activity which will build the bond between the students in the class and work as a team in the task given to them. The students will be asked to introduce their new best friend in the class. This will ensure that the bond being created here will stay strong and also break the ice between them.	**5**	**01**
2	**Picture Connector** In this class the students will be trained to form a logical connection between a set of pictures which will be shared with This geared towards building creativity and presentation skills.	**5**	**01**
3	**Crazy Scientist** The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	**5**	**01**
4	**Shopping Role Play** This activity topic gears towards making students do role play based on shopping scenarios. It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it.	**5**	**01**
5	**Grammar** Parts of speech, Active and Passive voice, Tenses.	**20**	**10**
6	**Communication: Theory & Practice** Basics of communication: Introduction, meaning, definition, Process of communication. Types of communication: Formal, Informal, Verbal/Non verbal and Written barriers to effective communication. 7 Cs of effective communication: (considerate, concrete concise, clear, complete, correct and courteous). Technical Communication	**12**	**05**
7	**Soft Skills for Professional Excellence** Introduction: Soft skills and hard skills, Importance of soft skills.	**12**	**02**
8	**Debate** Students are trained to let go of inhibitions and come forward and speak openly on passionate topics. The students will be divided into teams and made to share their ideas and views on the topics.	**5**	**01**
9	**Extempore** To change the average speakers in the class to some of the best Orators. This will be done by making the students give a variety of impromptu speeches in front of the class.	**5**	**01**
10	**Letter Writing** Types of letters-Inquiry letter, Order letter, Complaint letter, Adjustment, Request letter, Recommendation letter. Format of letters.	**12**	**02**
11	**Reading Comprehension** Dabbawallas, A Snake in the grass, Internet – Dr. Jagdish Joshi	**14**	**5**
	Total	**100**	**30**

i) Text Book and Reference Book:

1. **Technical Communication: Principles And Practice**
   By Sangeetha Sharma, Meenakshi Raman | Oxford University Press
2. **An An English grammar: comprehending the principles and rules of the language, illustrated by appropriate (v.1)** By Murray, Lindley | York England: Printed by Thomas Wilson & Sons, for Longman, Hurst, Rees, Orme, and Brown; and Dart Fourth edition
3. **Active English**
   By Juneja & Qureshi | Macmillan

SEMESTER 2

a) Course Name: Organic Chemistry

b) Course Code: 0362155

c) Prerequisite: Understanding of reaction condition and mechanism along with momenclature and isomerism.

d) Rationale: This course provides the basic knowledge of organic compounds and their chemical behavior.

e) Course Learning Objective:

CLOBJ 1	Describe the structure of organic molecules, including the types of bonds (single, double, triple), hybridization, and molecular geometry. They should understand concepts like resonance and aromaticity.
CLOBJ 2	Classify different functional groups (e.g., alcohols, aldehydes, ketones, carboxylic acids, amines) and understand their chemical properties and reactivity patterns.
CLOBJ 3	Visualize Organic compounds systematically according to IUPAC rules, including complex molecules with multiple functional groups and stereoisomers.
CLOBJ 4	Apply knowledge of reactions and mechanisms to design synthesis routes for target molecules. This includes selecting appropriate reagents and conditions to achieve the desired transformation.

f) Course Learning Outcomes:

CLO 1	Draw and interpret the structure of organic molecules, including the ability to recognize and represent various types of bonding and hybridization.
CLO 2	Predict the mechanisms of organic reactions, including identifying intermediates and transition states.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Decide Name organic molecules based on their functional groups, and predict their reactivity and physical properties.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**0**	**0**	**4**	**20**	**20**		**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit– I Concept of Organic Chemistry** Introduction -Classification of Hydrocarbons, Functional group classification of organic compound, IUPAC system of nomenclature. Structural Isomerism -Position Isomerism, Chain Isomerism, Mesmerism Isomerism, Functional Isomerism Stereo Isomerism- Optical isomerism, Geometrical Isomerism	**10**	**8**
2	**Unit– II Purification of Organic Compounds** tallization, Sublimation, Distillation-Simple distillation, Fractional distillation, Distillation under reduced pressure, Steam distillation, Tests of purification- M.P. & B.P. of organic compounds.	**10**	**7**
3	**Unit– III Detection & Estimation of Elements** Detection of C, H, N, halogens, S & P., Lasagna's Test for detection of N, Cl, Br, I & S., Estimation of C & H., Estimation of Nitrogen by Duma's method. Estimation of Nitrogen by Kjeldahl's method, Estimation of halogens, Sulphur and Phosphorous by Cariu'sMethod. Problems based on methods of estimation.	**15**	**8**
4	**Unit– IV Study of Aliphatic Compounds** Preparation, Properties (Physical and Chemical) & Uses of following Compounds. Alcohol, Aldehyde & Ketone (Methanol, Ethanol, Acetaldehyde & Acetone.) Carboxylic Acid (Acetic Acid & Oxalic), Esters and ether (Methyl& Ethyl Acetate & Diethyl ether), Amines (Methylamine, Ethyl Amine).	**20**	**12**
5	**Unit– V Study of Aromatic Compounds** eparation, Properties (Physical and Chemical) & Uses of following Compounds. Benzene & Toluene, Nitrobenzene & Aniline., Phenol & Benzaldehyde, Benzoic Acid & Salicylic Acid., Styrene. & Naphthalene, Anthracene and Urea, Benzamide	**20**	**12**
6	**Unit– VI Carbohydrates, Soaps & Detergent** Introduction**:** Carbohydrates and its classification with Suitable Examples and functions of carbohydrates Explain soaps and Detergent, Classification of soaps and detergent with suitable example of each class Mechanism of cleansing action	**10**	**5**

7	**Unit-VII Chemistry of Dyes** Define Dye, Difference between dye and color, Explain Chromogens, Chromophore, and Auxochrome, Classification of Dyes based on structure, Classification of Dyes based on method of application. Introduction to the Dyes, Natural to synthetic dyes, Classification of Dyes on the basis of structure and the mode of application to the fibers and Chemical constitution of dyes. Azo dyes, Mordant dyes. Anthraquinone (VAT) dyes, Indigoid dyes. Reactive dyes and Disperse dye: Introduction Classification and applications.	**15**	**8**
	Total	**100**	**60**

i) Text Book and Reference Book:

1. A Text Book of Organic Chemistry by Arun Bahl and B.S. Bahl | Sultan Chand & Sons, New Delhi
   Text Book Of Organic Chemistry by P. L. Soni | Sultan Chand & Sons, New Delhi
2. ENGINEERING CHEMISTRY By O.P AGRAWAL | KHANNA
   ENGINEERING CHEMISTRY By JAIN & JAIN | DHANPAT RAI
3. Organic Chemistry by Finar, I. L. | Dorling Kindersley (India) Pvt. Ltd. | Volume 1
   Organic Chemistry by By Morrison and Boyd

a) Course Name: Organic Chemistry Lab

b) Course Code: 03602152

c) Prerequisite: Reaction Condition and Mechanism along with Nomenclature and isomerism

d) Rationale: This course equips students with practical knowledge on organic compounds and their chemical behavior.

e) Course Learning Objective:

CLOBJ 1	Classify different functional groups (e.g., alcohols, aldehydes, ketones, carboxylic acids, amines) and understand their chemical properties and reactivity patterns.
CLOBJ 2	Decide according to IUPAC rules, including complex molecules with multiple functional groups and stereoisomers.
CLOBJ 3	Knowledge of reactions and mechanisms to design synthesis routes for target molecules.
CLOBJ 4	Critically analyze and evaluate experimental data, draw conclusions, and solve complex problems using their understanding of organic chemistry principles.
CLOBJ 5	Apply laboratory safety protocols and be aware of the environmental impact of chemical processes and waste disposal.

f) Course Learning Outcomes:

CLO 1	Identify and name organic molecules based on their functional groups, and predict their reactivity and physical properties.
CLO 2	Apply principles of laboratory safety and environmental impact, including proper waste disposal and risk management.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Examine skills to do experiments.
CLO 5	Perform organic laboratory techniques safely and effectively, including setting up reactions, purifying products, and analyzing results.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L - Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) Experiment List:

Exp. No.	Name of the Experiment
1	All Physically Observing of Organic Acid, Base, Phenol & Neutral Compounds. (Their physical state, Structural formula & Solubility).
2	Purification of a given organic compound by crystallization.
3	Purification of a given organic compound by Solvent Treatment method.
4	Detection of Melting point and Boiling point of some Organic Solids by Thiele's Method.
5	Separation of some Organic Compounds (Acid + Phenol + Base) using solvent treatment method.
6	Preparation of some compounds such as I) Nitrobenzene from Benzene.
7	Purification of some organic compounds by Sublimation method.
8	Detection of some Elements by Lasagna's test.
9	Practical are to be performed based on the organic spotting of the following compounds. Organic Qualitative Analysis I) Acetic Acid & Benzoic Acid (ii) Aniline & Nitrobenzene iii) Benzene & Acetone (iv) Chloroform & Phenol.

i) Text Book and Reference Book:

1. A Text Book of Organic Chemistry by Arun Bahl and B.S. Bahl | Sultan Chand & Sons, New Delhi
2. Text Book Of Organic Chemistry by P. L. Soni | Sultan Chand & Sons, New Delhi
3. ENGINEERING CHEMISTRY By O.P AGRAWAL | KHANNA
4. ENGINEERING CHEMISTRY By JAIN & JAIN | DHANPAT RAI
5. Organic Chemistry by Finar, I. L. | Dorling Kindersley (India) Pvt. Ltd. | Volume 1
6. Organic Chemistry by Morrison and Boyd

a) Course Name: Molecular Biology

b) Course Code: 03630152

c) Prerequisite: Knowledge of basic Biology up to 10th class.

d) Rationale: To provide a basic understanding of molecules present in cells like DNA & RNA.

e) Course Learning Objective:

CLOBJ 1	To describe the organization and structure of viral, prokaryotic, and eukaryotic genomes, including chromatin, nucleosomes, and chromosomes.
CLOBJ 2	To explain the mechanisms of DNA replication, DNA polymerases, and the relationship between replication and the cell cycle in prokaryotes and eukaryotes.
CLOBJ 3	To identify types of DNA damage and describe the various DNA repair mechanisms, including nucleotide excision repair and base excision repair.
CLOBJ 4	To analyze the role of transposable elements and understand the processes of transcription and gene expression in prokaryotes and eukaryotes.
CLOBJ 5	To understand the components, mechanisms, and regulation of protein synthesis, as well as post-translational modifications and protein transport.

f) Course Learning Outcomes:

CLO 1	Understand the genome structure and organization of prokaryotic and eukaryotic cells.
CLO 2	Familiarize with the DNA replication, repair mechanism and transcription processes.
CLO 3	Understand the basics of transposable elements and transcription process.
CLO 4	Impart an understanding about gene expression and regulation in various types of cell.
CLO 5	Understand the basics concept of protein synthesis.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching hours**

1	**Genome Structure and Organization** Definition and organization of viral, prokaryotic and eukaryotic genomes. Structure of chromatin, nucleosome, chromosome, centromere, telomere. C value paradox and genome size, Organelle genomes.	**20**	**12**
2	**DNA Replication, Damage and Repair** DNA Replication DNA polymerases and mechanisms of DNA replication in prokaryotes and eukaryotes DNA replication models, connection of replication to cell cycle, Gene amplification (rRNA) Reverse Transcriptase. DNA damage and Repair Types of DNA damage, DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair.	**30**	**11**
3	**Transposable Elements and Transcription Process** Mobile DNA elements Transposable elements in bacteria, replicative and non-replicative transposons. SINES and LINES, retrotransposons. Gene Expression in Prokaryotes and Eukaryotes Transcription: Basic mechanism in prokaryotes and eukaryotes. RNA polymerases, Regulation of transcription including transcription factors.	**30**	**12**
4	**Protein Synthesis** Protein Synthesis, Modifications and Transport Components of protein synthesis, Mechanism of protein synthesis, Genetic code Regulation of protein synthesis.	**20**	**10**
	Total	**100**	**45**

i) Text Book and Reference Book:

1. Test Book of Molecular Biology (TextBook)
By K.S. Sastry, G. Padmanabhan& C. Subramanyan | Macmillan India
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA
By Glick and Pasternack
3. Molecular Biology (TextBook)
By D. Freifelder | Narosa
4. Molecular Biology
By Robert Weaver | McGraw-Hill | 5th

a) **Course Name:** Basic of Chemical Engineering Thermodynamics

b) **Course Code:** 03630153

c) **Prerequisite:** Concepts of Thermodynamics

d) **Rationale**: The basic aim of this subject is to provide a clear understanding to the students about the laws of thermodynamics and its allied concepts.

e) **Course Learning Objective:**

CLOBJ 1	To differentiate between various systems, their functions, properties, and processes in thermodynamics.
CLOBJ 2	To explain the fundamental principles and implications of the laws of thermodynamics, including their relevance to engineering and scientific applications
CLOBJ 3	To analyze and solve problems involving the first law of thermodynamics for both non-flow and flow processes in practical systems.
CLOBJ 4	To assess the Pressure-Volume-Temperature (PVT) behavior of fluids and apply relevant equations of state to real-world scenarios
CLOBJ 5	To apply the concepts of the second law of thermodynamics to analyze energy conversion efficiency and entropy changes in various processes.

f) **Course Learning Outcomes:**

CLO 1	Distinguish systems, functions, properties and processes
CLO 2	Explain various laws of Thermodynamics
CLO 3	Implement the first law of thermodynamics for non-flow & flow process.
CLO 4	Access the PVT behaviour of the fluids.
CLO 5	Apply the concepts of second law of thermodynamics.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction** Basic concepts – systems, surroundings, processes, properties (extensive/intensive), components (single/ multi), phases (G/L/S), ideality, zeroth, first law of thermodynamics and their consequences (T, U, S)	**10**	**8**
2	**Thermodynamic functions** Thermodynamic functions - The thermodynamic functions H, A and G, concept of chemical potential, equations for a closed system, Maxwell's relations, thermodynamic analysis of processes – lost work, irreversibility, thoughts on Classical and Statistical Thermodynamics in the context of Biological Processes and Systems. Thermodynamics of solutions: Partial molar properties, fugacity, ideal and non-ideal solutions, excess properties of mixtures, activity coefficient, Gibbs-Duhem equation	**30**	**10**
3	**Thermodynamic properties of pure fluids** Review of ideal gas, non-ideal gas, PVT behaviour, virial and cubic equations of state, generalized correlations, residual properties, estimation of thermodynamic properties using equations of state	**30**	**10**
4	**Second law of thermodynamics** Statements, heat engines, Heat reservoir, Heat engine and Heat pump, concept of entropy, entropy changes, Mathematical statement of Second law, Entropy and Irreversibility, Simple numerical	**10**	**8**
5	**Phase and Reaction** Equilibria Phase rule, criteria for phase equilibria, VLE for pure component, VLE for multi-component system, Equilibrium criteria for homogenous reactions, evaluation of equilibrium constant, effect of temperature and pressure on equilibrium constant, calculation of equilibrium conversion and yields for single and multiple reactions.	**20**	**9**
	Total	**100**	**45**

i) Text Book and Reference Book:

1. Introduction to Thermodynamics (TextBook)
By Y.V.C. Rao | Wiley Eastern Limited | 2nd Edition
2. "Chemical, Biochemical and Engineering Thermodynamics",
By S.Sandler, | 4th edition, Wiley,India
3. Introduction to Chemical Engineering Thermodynamics
By – Smith, J.M., Van Ness, H.C., & Abbot M. C, | McGraw Hill VII Edition 2004.

a) Course Name: Basics of Immunology

b) Course Code: 03630156

c) Prerequisite: Knowledge of basics of biology and molecular biology.

d) Rationale: To provide a basic understanding of our immune system and immunological aspects.

e) Course Learning Objective:

CLOBJ 1	To explain the structure, types, and roles of cells involved in the immune system.
CLOBJ 2	To elaborate on the mechanisms and components of innate and adaptive immunity.
CLOBJ 3	To compare the characteristics, structures, and functions of antigens in the immune response.
CLOBJ 4	To extend knowledge about antibodies, including their characteristics, functions, and advanced production techniques.

f) Course Learning Outcomes:

CLO 1	Explain the cells of the immune systems.
CLO 2	Elaborate innate and adaptive immunity.
CLO 3	Compare the characteristics, structures and functions of the antigens.
CLO 4	Extend the knowledge about antibodies and their production techniques.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching hours**

1	**Overview of Immune System** Historical perspective of Immunology and the early theories of Immunology. Types of immunity- Innate, Adaptive (cell mediated and humoral)	**20**	**6**
2	**Innate and Adaptive Immunity** Physical barrier, Chemical barrier and biological barrier, B-lymphocytes, T-lymphocytes and Antigen presenting cell	**30**	**9**
3	**Antigens** Characteristics of antigen, types of antigens, Immunogenicity Versus Antigenicity, Factors that Influence Immunogenicity, Epitopes, Haptens and the Study of Antigenicity, Pattern-Recognition Receptors	**20**	**6**
4	**Antibodies** Immunoglobulins - Structure and Functions, classes and function. Monoclonal antibodies, Hybridoma technology	**30**	**9**
	Total	**100**	**30**

i) Text Book and Reference Book:

1. Immunology (TextBook)
By Goldsby. R.A, Kindt.T.J, Kuby J and Osborne BA | W.H. Freeman Pubn. New York | 7th, Pub. Year 2014
2. Fundamental Immunology
By R.M. Coleman, M.F. Lombard, R.E.Sichard. | Bookbarn International | 5th, Pub. Year 2014
3. Roitt's Essential Immunology (TextBook)
By Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. | Roitt's, Blackwell Publishing

a) **Course Name:** Fundamentals of Microbiology

b) **Course Code:** 03630159

c) **Prerequisite:** Basic knowledge about biology.

d) **Rationale**: This course helps to understand about the microbes their structures, functions and different societal benefits.

e) **Course Learning Objective:**

CLOBJ 1	To summarize the historical development and diverse roles of microbes in nature and human life.
CLOBJ 2	To illustrate the structural features of various microbes and their significance in microbial classification.
CLOBJ 3	To utilize the principles and techniques of staining to study microbial morphology and identification.
CLOBJ 4	To categorize the diverse applications of microbiology across fields such as healthcare, agriculture, and industry.

f) **Course Learning Outcomes:**

CLO 1	Summarize the history and multifaceted existence of microbes.
CLO 2	Illustrate the structural features of microbes.
CLO 3	Utilize the principles of staining.
CLO 4	Categorize the different applications of microbiology in the various fields.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Content**	**Weightage (%)**	**Teaching hours**
1	**History and Scope of Microbiology** Introduction- Definition, scope and Spontaneous generation vs. biogenesis. History of Microbiology- Domain and kingdom concepts, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander	**20**	**5**

	Flemming Role of microorganisms in fermentation, Germ theory of disease.		
2	**Classification and Structure of Microbes** Difference between prokaryotic and eukaryotic microorganisms. Brief outline of Bergey's manual of systemic bacteriology. Structural organization of bacteria – Size, shape and arrangement of bacterial cells. Discovery of viruses, Structure of viruses, Classification of viruses (LHT System), Replication of viruses – Lytic cycle (T4), Lysogeny (Lambda phage).	**30**	**10**
3	**Stains and Staining** Principles of staining, simple staining, negative staining, differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore staining.	**20**	**5**
4	**Applications of Microbiology** Agriculture – Biofertilizers & Biopesticides, Human and Animal Health – Antibiotics, Food, Chemical & Pharmaceutical Industries, Environmental – Biodegradation and Bioleaching, GMOs.	**30**	**10**
Total		**100**	**30**

i) Text Book and Reference Book:

1. General Microbiology Vol. I & II
By Power & Daginawala | Himalaya Publication
2. Principles of Microbiology (TextBook)
By Geeta Sumbali and Mehrotra R.S | Tata McGraw Hill P. Ltd., New Delhi. | 1st Edition, Pub. Year 2009
3. A Text of Microbiology (TextBook)
By Dubey R.C and Maheswari D.K. | S. Chand & Company Ltd., New Delhi. | Revised edition, Pub. Year 2012

a) **Course Name:** Fundamentals of Microbiology Lab

b) **Course Code:** 03630160

c) **Prerequisite:** Basic knowledge about biology

d) **Rationale:** This course helps to understand about the microbes their structures, functions and different societal benefits.

e) **Course Learning Objective**

CLOBJ 1	To utilize various standard laboratory procedures for conducting experiments and ensuring accurate results.
CLOBJ 2	To demonstrate the working principles and proper use of laboratory instruments in microbiology.
CLOBJ 3	To experiment with techniques for isolating bacteria and understanding their growth characteristics.
CLOBJ 4	To adapt to handling and operating the microscope effectively for microbial observation.
CLOBJ 5	To analyze bacterial samples using Gram's staining method for accurate identification and classification.

f) **Course Learning Outcomes:**

CLO 1	Utilize the various standard laboratory procedures.
CLO 2	Demonstrate the working principles of instruments.
CLO 3	Experiment with the isolation of bacteria.
CLO 4	Adapt with how to handle the microscope.
CLO 5	Analyze the Gram's stain for bacteria identification.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**

1.	Demonstration of Safety & Good laboratory practices.
2.	Demonstration of Principles and operations – Autoclave, Hot Air Oven, Incubators, Laminar Air Flow chamber, Filtration,colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer.
3.	Demonstration of Microscopy – Parts and functions of a compound microscope.
4.	Preparation of culture media – solid, semi-solid and liquid.
5.	Perform Isolation of bacteria from soil.
6.	Perform Isolation of bacteria from water.
7.	Perform Pure culture techniques by Streak plate.
8.	Perform Pure culture techniques by Spread plate.
9.	Perform Microscopic Examination of bacteria by Gram's staining.
10.	Demonstration of growth curve of bacteria.

a) Course Name: Engineering Workshop Practice

b) Course Code: 03609154

c) Prerequisite: Learn about fundamentals of mechanical and electrical engineering.

d) Rationale: This course equips students with relevant technical hand skills required by the technician.

e) Course Learning Objective

CLOBJ 1	Develop a thorough understanding of workshop safety procedures, including the proper use of personal protective equipment (PPE), safe operation of machinery, and adherence to safety regulations.
CLOBJ 2	Motive hand tools, power tools, and workshop machinery, including lathes, milling machines, drills, and grinders, to perform precise engineering tasks.
CLOBJ 3	Accurately measure and mark materials using various measurement tools (calipers, micrometers, rulers) and techniques to ensure precision in engineering projects.
CLOBJ 4	Relate and interpret technical drawings and blueprints to guide the construction and assembly of engineering components and projects.
CLOBJ 5	Apply techniques for cutting, shaping, and finishing materials (metal, wood, plastic) using appropriate workshop methods and tools to achieve desired specifications.

f) Course Learning Outcomes:

CLO 1	Basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines
CLO 2	Job drawing and complete jobs as per specifications in allotted time. Inspect the job for the desired dimensions and shape. Operate, control different machines and equipment's adopting safety practices.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Exp. No.	Name of the Experiment
1.	**To A Perform a Job in Carpentry Shop.** Types, sketch, specification, material, applications and methods of using of carpentry tools- saws, planner, chisels, hammers, pallet, marking gauge, vice, try square, rule, etc., Types of woods and their applications., Types of carpentry hardware 's and their uses., Demonstration of carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, etc., Preparation of wooden joints., Safety precautions.

2.	**To A Perform a Job in Tim Smithy.** Concept and conversions of SWG and other gauges in use., Use of wire gauge., Types of sheet metal joints and application., Types, sketch, specification, material, applications and methods of using tin smithy tools-hammers, stakes, scissors/snips, etc., Demonstration of various tin smithy tools and sheet metal operations such as shearing, bending and joining., Preparation of tin smithy job., Safety precautions
3.	**To Perform a Job on Fitting Practice.** Sketch, specification and applications of fitting work holding tools-bench vise, V-block with clamp and C-clamp., Sketch, specification , material ,applications and methods of using fitting marking and measuring tools-marking table, surface plate, angle plate, universal cribbing block, try-square, scriber, divider, center punch, letter punch, calipers, Vernier caliper, etc., Types, sketch, specification , material , applications and methods of using of fitting cutting tools hacksaw, chisels, twist drill, taps, files, dies., Types, sketch, specification, material, applications and methods of using of fitting finishing tools-files, reamers., Sketch, specification and applications of miscellaneous tools-hammer, spanners, screw drivers sliding screw wrench., Demonstration of various fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping., Preparation of simple and male- female joints., Safety precautions.
4.	**To Perform a Job on Soldering.**
5.	**To Perform a Job on Welding.** Demonstration of different welding tools / machines., Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding., One simple job involving butt and lap joint., Safety precautions.
6.	**To Perform a Job on plumbing.** Types, specification, material and applications of pipes., Types, specification, material and applications of pipe fittings., Types, specifications, material, applications and demonstration of pipe fitting tools., Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling, etc., Types and application of various spanners such as flat, fix, ring, box, adjustable, etc., Preparation of pipe fitting jobs., Safety precautions.
7.	**To Perform a Job on Sheet Metal Practice.**
8.	**Identify Different symbol used in electrical installation and prepare sheet.** Demonstration of electrical symbol used in domestic or industrial wiring., Demonstration of electrical wiring tools and accessories., Demonstration of electrical measuring instruments like voltmeter, Ammeter, Wattmeter., Demonstration of advanced tools used in testing of electrical installation like Multi meter, Clip-on meter, Megger, Tachometer, Tester etc.
9.	**Identify the different tools used in electrical installation.** Demonstration of electrical wiring tools and accessories.
10.	**Demonstration of measuring instrument Voltmeter, Ammeter, Wattmeter.** Demonstration of electrical measuring instruments like voltmeter, Ammeter, Wattmeter.
11.	**Demonstration of testing instruments: Multi meter, Clip-on meter, Megger, Line tester.** Demonstration of advanced tools used in testing of electrical installation like Multi meter, Clip-on meter, Megger, Tachometer, Tester etc.
12.	**Demonstration of different cables used in electrical installation.** Single core cable, multicore cable, single strand wire, multi strand wire, shielded wire
13.	**Demonstration of different switches used in electrical installation.** Demonstration of different switches like Toggle switch, Rotary switches, Push button switch etc.

14.	**Demonstration of protective devices: fuse, MCB, ELCB.** Demonstration of protective devices like fuse, MCB, ELCB.

i) Text Book and Reference Book:

1. **Mechanical workshop practice**
   By K.C. John
2. **A Textbook of Electrical Workshop Practices**
   By Dr. Umesh Rathore | S.K. Kataria & Sons
3. **A Course in Workshop Technology**
   By Raghuvamsa B S | Dhanpati Rai and Sons, 1682 Nai Darak, New Delhi. Pub. Year 1982
4. **Workshop Practice Manual**
   By K. Venkat Reddy | BS Publications
5. **Elements of Workshop Technology Vol. I**
   By Hajra Chaudhary S.K. | Asia Publishing House
6. **Comprehensive Workshop Technology**
   By S.K. Garg | Laxmi publications

a) Course Name: Mathematics-II

b) Course Code: 03691151

c) Prerequisite: Knowledge of Basic concept of mathematics studied till semester

d) Rationale: This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, integral calculus and vector algebra.

e) Course Learning Objective:

CLOBJ 1	Develop a strong foundation in essential mathematical concepts, including algebra, calculus, geometry, trigonometry, and statistics, to solve real-world and theoretical problems.
CLOBJ 2	Accurate and efficient computations, both manually and using mathematical software tools, to solve algebraic equations, differential equations, and integrals.
CLOBJ 3	Recall mathematical ideas clearly and effectively in both written and oral forms, using appropriate notation, language, and logical structure to communicate solutions and reasoning.

f) Course Learning Outcomes:

CLO 1	Inspect algebraic operations on matrices and Analysis solution of systems of linear equations
CLO2	Definite Integration to solve engineering problems
CLO 3	Defend algebra of vectors in finding work done, moment, velocity
CLO 4	Solve differential equation arising in different Engineering branch and able to form mathematical & physical interpretation of its solution which place important role in all branches of Engineering

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teachig Hours
1	**Unit I: Determinants and Matrices** Elementary properties of determinants up to 3rd order, consistency of equations, Crammer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.	**22**	**12**

2	**Unit II: Vector Algebra** Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.	**13**	**6**
3	**Unit III: Co-Ordinate Geometry** Straight line Inclination and slope of a line, different forms of equations to a straight line, Slope-intercept form, and Point slope form, Two-point form, Intercept form. General equation of a Straight line, Family of lines. Conditions for concurrency of lines. Circle Definition, Equation of a circle with given center and radius, General form of equation of circle, Equation of a circle when intercepts are given, circle passing through three points, Equation of chord, Equations of tangents and normal at a point on a circle.	**15**	**10**
4	**Unit IV: Integral Calculus** Integration as inverse operation of differentiation, Integration of simple functions, Integration by substitution, by parts and by partial fractions (for linear factors only). Definite integral: Definition, Properties of Definite integral, Odd and Even functions, Use of formulas, and for solving problems Where m and n are positive integers. Applications of integration for I. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems)	**37**	**10**
5	**Unit V: Differential Equations** Solution of first order and first-degree differential equation by variable separation method (simple problems), Exact differential equations (simple problems), Linear differential equations (simple problems), MATLAB – Simple Introduction.	**13**	**7**
	Total	**100**	**45**

a) **Course Name:** Communication Skills – II

b) **Course Code:** 03693153

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Basic Communication skills are essential for all Diploma Engineers.

e) **Course Learning Objective:**

CLOBJ 1	Develop learning & establish a platform for the students that they can easily learn through various life skills required in the organization for becoming an asset for the organization.
CLOBJ 2	Analyze new words are formed, role of syllable, vowel, consonant in pronunciation of word.
CLOBJ 3	Enhance formal communication as well as to participate in events like debate, extempore etc, and to introduce them to various international Language testing systems
CLOBJ 4	Encourage them to overcome stage fear through classroom activities.
CLOBJ 5	Cultivate Reading Skill through the usage of comprehensions.

f) **Course Learning Outcomes:**

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO 2	Apply and analyze the right kind of pronunciation with regards to speech sounds and be able to get different types of pronunciations.
CLO 3	Competent to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/ lifestyle and the expected corporate behavior cum lifestyle with the help of learning life skills.
CLO 4	Apply the concepts of grammar, various strategies and the usage of formal language in written expression. By using synonyms rewrite the same text in the same format and meaning. Write the gist of the given text.
CLO 5	Enhanced ability to understand and interpret written texts, leading to better grasp of subject matter across disciplines.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching Hours
1	**Listening Skills** Listening Process and Practice - Introduction, importance of good Listening Skills, difference between listening and hearing, types of listening, Barriers to effective Listening, traits of a good listener.	**15**	**6**
2	**Listening Skills – Questions** With audio aids, Students will be able to listen to dialogues, improve in gathering information and to summarize the content. To listen and understand day-to-day conversations and to solve questions based on audio files.	**10**	**1**
3	**Building Vocabulary** Synonyms, Antonyms, Homophones, Homonyms, Homographs, Phrasal verbs, idioms & phrases, One word substitution.	**15**	**1**
4	**Introduction to Phonetics** Sounds: Consonant, Vowel, Diphthongs, transcription of words (IPA) weak forms, syllable division, word stress, intonation and voice.	**15**	**6**
5	**Speaking Skill Building Introduction** To enable students to eliminate stage fright and engage in conversation with others.	**5**	**2**
6	**Speaking Skill Building Activity** Enables students to engage in formal communication as well as to participate in events like debate, extempore etc., and to introduce them to various international Language testing systems.	**5**	**1**
7	**Tourism Pitch** Classroom activity which helps students to express their feelings and experiences in English. Encouraging students to overcome stage fear.	**5**	**1**
8	**Lifeboat** Classroom Activity to encourage Communication and Convincing Skills.	**5**	**1**
9	**Reporter** Classroom activity to encourage Communication and Convincing Skills.	**5**	**1**
10	**Paragraph Jumble** Enhance the skill of writing by completing the paragraph in appropriate and sensible form.	**5**	**4**
11	**Life Skills** Self-Awareness, Sympathy, Empathy, Emotional Intelligence.	**5**	**4**
12	**Reading Comprehension** A Day's Wait- Ernest Hemingway, My Lost Dollar - Stephen Leacock.	**10**	**2**
	Total	**100**	**30**

I) Text Book and Reference Book:

1. **Technical Communication: Principles And Practice**
   By Sangeetha Sharma, Meenakshi Raman | Oxford University Press
2. **Effective Technical Communication**
   By Dr. Bharti Kukreja, Dr. Anupama Jain | S.K. Kataria & Sons | 1st
3. **Active English**
   By Juneja & Qureshi | Macmillan

SEMESTER 3

a) Course Name: Entrepreneurship and Start-ups

b) Course Code: 03600201

c) Prerequisite: Understanding of financial statements (income statement, balance sheet, and cash flow statement), budgeting, and financial planning.

d) Rationale: The main objective of this course is to understanding the concept and process of entrepreneurship.

e) Course Learning Objective:

CLO 1	Assume key concepts of entrepreneurship, including the entrepreneurial mindset, types of entrepreneurships, and the role of innovation in creating new ventures.
CLO2	Defend market research to assess industry trends, identify target markets, analyze competitors, and determine customer needs.
CLO 3	Make up a comprehensive business plan that includes an executive summary, market analysis, organizational structure, product/service description, marketing strategy, financial projections, and funding requirements.
CLO 4	Create and manage financial plans, including budgeting, financial forecasting, and understanding financial statements and metrics

f) Course Learning Outcomes:

CLO 1	Inspect the dynamic role of entrepreneurship and small businesses
CLO2	Organizing and Managing a Small Business
CLO 3	Relate Financial Planning and Control
CLO 4	Solve Strategic Marketing Planning
CLO 5	Organize New Product or Service Development
CLO 6	Classify Business Plan Creation

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	-	1	-	20	20	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching Hours
1	**Introduction to Entrepreneurship and Start – Up** Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation, Types of Business Structures,Similarities/differences between entrepreneurs and managers.	15	5
2	**Business Ideas and their implementation** Discovering ideas and visualizing the business, Activity map, Business Plan	15	2

3	**Idea to Start-up** Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis	**20**	**2**
4	**Management** Company's Organization Structure: Recruitment and management of talent	**20**	**2**
5	**Financing and Protection of Ideas** Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses	**20**	**2**
6	**Exit strategies for entrepreneurs** Exit strategies for entrepreneurs, bankruptcy, succession and harvesting strategy	**10**	**2**
	Total	**100**	**15**

i) Text Book and Reference Book:

1. **Entrepreneurial Development**
   By Srinivasan. N. P | New Delhi: S. Chand 1999
2. **ENTREPRENEURAL DEVELOPMENT**
   By Vasant Desai | Himalaya Publication
3. **Entrepreneurial Development**
   By David Holt

a) Course Name: Life science-I

b) Course Code: 03630201

c) Prerequisite: Basic Concepts of Human Body Organization

d) Rationale: The students need to learn fundamentals of anatomical structures and physiology of body organs.

e) Course Learning Objective:

CLOBJ 1	To explain the structures of different body parts and their anatomical organization.
CLOBJ 2	To describe the physiology and functional processes of various body organs.
CLOBJ 3	To explain the mechanisms underlying the functioning of different body systems.
CLOBJ 4	To describe the structure and functions of blood, blood vessels, and their role in circulation.
CLOBJ 5	To understand the interconnectivity and roles of various body systems in maintaining overall health.

f) Course Learning Outcomes:

CLO 1	Explain the structures of different body parts.
CLO 2	Describe the physiology of body organs.
CLO 3	Explain the mechanism of system functioning.
CLO 4	Describe the structure and functions of the blood & blood vessel.
CLO 5	Understand the various body systems.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Cell and Tissues** Physical Structure of the Cell, Types of tissue, its location, properties & function	**10**	**6**
2	**Elements of Human Anatomy & General Physiology** Terms related to Anatomy, Anatomical plane, Anatomical position, Functional System of the cell & its organelle, Homeostasis, Endocytosis, Exocytosis.	**10**	**10**
3	**Skeletal Muscle System** Structure & formation of Bone, Young bone, Adult bone, Types of the bone, Blood supply to the bone, applied anatomy of the bone, Joints & its types, Applied anatomy of joints, Muscle & its types, Muscle fasciculi, Applied anatomy of muscle. Transport of Ions and Molecules through the cell membrane; Membrane Potentials and Action Potentials; Inhibition of Excitability, Recording Membrane potentials and Action potentials, skeletal muscle, Sarcomere, EMG, Neuron, neuromuscular transmission	**25**	**12**
4	**Body Fluid** Blood and its composition and function. Various Cells and their structures. Numbers Cell counting, Hemoglobin and its estimation, Anemia, Hemostasis, Blood Group.	**20**	**10**
5	**Respiratory System** Mechanism Of Respiration, Pulmonary Ventilation, Pulmonary Volumes and Capacities. Transport of Gases, Pulmonary function testing. Artificial Respiration, hypoxia	**15**	**10**
6	**Cardiovascular System** Structure of Heart, Heart valves, Arteries, Veins, blood supply of heart coronary circulation, Heart muscle, heart as a pump, Heart sound & blood pressure, cardiac cycle, Cardiac output. Conduction system of the heart, ECG, Arrhythmia.	**20**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **NCERT Biology Text book of 11th and 12th (TextBook)**
2. **Anatomy and physiology in Health and Illness**
By ROSS AND WILSON | Churchill Livingstone (Elsevier)
3. **Essential of medical physiology**
By Indu khurana
4. **General Anatomy**
By B.D. Chaurasia
5. **Physiologyof Human Body**
By Guyton
6. **Principles of General Anatomy**
By A.K.Datta

a) **Course Name:** Biochemical Calculations

b) **Course Code:** 03630206

c) **Prerequisite:** Basic Concepts of Chemistry, Physics and Biology.

d) **Rationale**: To develop basic skills of the students with emphasis on to solve mathematical problems in general biochemistry.

e) **Course Learning Objective:**

CLOBJ 1	To develop a fundamental understanding of the basic principles and methods of unit conversion in general biochemistry.
CLOBJ 2	To understand the foundational concepts of biochemical engineering processes and perform associated calculations.
CLOBJ 3	To understand the principles of acid-base chemistry and their relevance in biochemical systems
CLOBJ 4	To understand the chemistry, structure, and functions of biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.
CLOBJ 5	To understand the basics of enzyme kinetics, including reaction rates and inhibition mechanisms.

f) **Course Learning Outcomes:**

CLO 1	Develop a fundamental understanding of the basic principles of unit conversion in general biochemistry.
CLO 2	Understand basic biochemical engineering processes and its calculations.
CLO 3	Understand the basics of acid-base chemistry.
CLO 4	Understand the concept of chemistry of biomolecules.
CLO 5	Understand the basics of enzyme kinetics and inhibition.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Dimensions and Units** Dimensions and system of units, Fundamental and derived units, Dimensional consistency, Dimensional equations, Different ways of expressing units of quantities and physical constant, Unit conversion and its significance.	**15**	**12**
2	**Basic Chemical Calculations** Calculations for mole, molecular weight, equivalent weight, etc., Composition of gaseous mixtures, liquid mixtures, solid mixtures, etc., Ideal gas law & other equations of state and their applications, Dalton's law, Raoult's law, Henry's law, Solutions and their properties.	**15**	**12**
3	**Acid and Base Chemistry** Aqueous solutions, Equilibrium constant, Acids and bases, Laboratory Buffers, Blood Buffers, Case studies and practice problems related to different buffer systems like Phosphate buffer, Tris buffer, Blood buffers, MOPS, HEPES, Bicarbonate buffer, Ammonium buffers.	**20**	**12**
4	**Chemistry of Biological Molecules** Carbohydrates, Lipids, Amino acids, Peptides, Proteins, Nucleotides and Nucleic Acids, Practice Problems related to proteins, peptides and amino acids.	**25**	**12**
5	**Enzyme Kinetics and Enzyme Inhibition** Enzymes are biological catalysts, Enzyme kinetics, Reaction order, Methods of plotting enzyme kinetics data, Effect of pH and Temperature on Enzyme stability and activity, Enzyme inhibition: Competitive, Non-competitive, and Uncompetitive.	**25**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry (TextBook)**
By Segel, I. H. | Wiley, Italy, Pub. Year 1976
2. **Fundamentals of Enzymology**
By Lewis Stevens, Nicholas C. Price, | Oxford University Press | 3rd, Pub. Year 1999
3. **Stoichiometry**
By B.I. Bhatt, S.M. Vora | McGraw Hill Publishing Company Limited | 4th, Pub. Year 2004
4. **Stoichiometry and Process Calculations**
By K.V. Narayanan, B. Lakshmikutty | Prentice Hall of India Pvt.Ltd

a) Course Name: Bioenergetics

b) Course Code: 03630207

c) Prerequisite: Basic Concepts of Chemistry, Physics and Biology.

d) Rationale: For the basic understanding of how the biomolecules release energy during metabolism.

e) Course Learning Objective:

CLOBJ 1	To summarize the processes of energy metabolism involved in biochemical reactions.
CLOBJ 2	To contrast the basic mechanisms and roles of biomolecules in various metabolic pathways.
CLOBJ 3	To understand the principles of biochemical energetics and the regulation of metabolic reactions.
CLOBJ 4	To become familiar with the applications of bioenergetics in biotechnology and its role in innovation.

f) Course Learning Outcomes:

CLO 1	Summarize the energy metabolism in the biochemical reactions.
CLO 2	Contrast on the basic mechanism of biomolecules in metabolic pathways.
CLO 3	Understand the concept of biochemical energetics and regulation of metabolic reactions.
CLO 4	Familiar with the applications of bioenergetics in the biotechnology.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching hours**
1	**Metabolic Pathways** Elucidation of metabolic pathways, logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; unifying themes of metabolic pathways.	**25**	**15**

2	**Energy and Metabolism** ATP-Structure, properties and energy currency of the cell, Importance of Coupled reactions, High energy compounds, and simple problems. Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic, and amphibolic pathways, Carbohydrate, lipid, and amino acid metabolism.	**25**	**15**
3	**Bio-Energetics** Energy-yielding and energy-requiring reactions, Calculations of Equilibrium Concentrations, Oxidation-Reduction Reactions, Metabolism and ATP yield, Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F1 -F0 ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation; Photosynthesis − chloroplasts and two photosystems; proton gradient across the thylakoid membrane. Active Transport, Enthalpy, and Entropy, Activation Energy.	**35**	**20**
4	**Applications of Bioenergetics in Biotechnology** Protein structure determination, Insulin emission in type-2 diabetes (T2D), Regulation of cholesterol, Biofuel generation, Cellular respiration, Structure-function relationships of disease-causing mutations.	**15**	**10**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **A text book of Chemical Engineering Thermodynamics (TextBook)**
By K. V. Narayanan | Prentice-Hall of India Pvt. Ltd.
2. **"Chemical, Biochemical and Engineering Thermodynamics",**
By S.Sandler, | 4th edition, Wiley,India
3. **Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry**
By Segel, I. H. | Wiley, Italy,, Pub. Year 1976
4.**Fundamentals of Biochemistry**
By Voet & Voet | John Willey & Sons

a) **Course Name:** Bioprocess Engineering

b) **Course Code:** 03630209

c) **Prerequisite:** Basic knowledge of Biotechnology, basic maths, physics and fluid mechanics.

d) **Rationale**: This course will enable the students to understand the fundamentals of bioreactors and allied concepts.

e) **Course Learning Objective:**

CLOBJ 1	To understand the fundamental concepts and principles of bioprocess engineering and their industrial applications.
CLOBJ 2	To infer the significance of sterilization techniques in maintaining aseptic conditions during bioprocessing.
CLOBJ 3	To design batch and continuous bioreactors, incorporating scale-up concepts for industrial-scale production.
CLOBJ 4	To develop kinetic parameters for microbial growth and product formation to optimize bioprocess efficiency.
CLOBJ 5	To distinguish between scale-up techniques and instrumentation requirements in the operation of fermenters.

f) **Course Learning Outcomes:**

CLO 1	Understand the concept of bioprocess engineering.
CLO 2	Infer the importance of sterilization.
CLO 3	Design batch and continuous bioreactors and scale-up concepts.
CLO 4	Develop the kinetic parameters for microbial growth and product formation.
CLO 5	Distinguish between scale up and instrumentation in fermenters.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction** Role of a bioprocess engineer, Layout of a Fermenter, What is Fermentation? What is submerged and solid-state fermentation processes? Material and Energy balances.	**20**	**12**
2	**Sterilization of Media and Air** Media sterilization; What are batch and continuous thermal sterilization, What are the different types of sterilization processes, The Concept of thermal death point, and del factor. Sterilization of air and filter design, What are the types of sterilization, Features of a filter, Sterilization efficiency.	**20**	**12**
3	**Reactor Classification and Analysis** Types of reactors: Stirred tank reactor, plug flow reactor (PFR), fluidized bed reactor, bubble column, airlift reactor. Mode of operation of reactors: Batch, fed-batch, and continuous processes.	**20**	**12**
4	**Microbial Growth Kinetics** Kinetics of microbial growth and product formation, What is a primary and secondary product? concept of specific growth rate, doubling time, maintenance coefficient.	**20**	**12**
5	**Scale-up Concepts and Instrumentation in a Fermenter** What is scale-up and its application, what probes are present in a fermenter and its use, and what is online data collection? Concept of block diagram. Developing a block diagram depicting scale up of bioethanol production from lab scale to industrial scale.	**20**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Bioprocess Engineering Principles (TextBook)**
By Paulin M Doran | Elsevier science and technology publication | 2nd
2. **Biochemical engineering fundamentals**
By James E Bailey, David F., Ollis, | McGraw Hill Intl. Edition. | 2nd
3. Bioprocess engineering: Basic concepts
By Shuler, M. L., Kargi, F., & DeLisa, M. | Pearson. | 3, Pub. Year 2017

a) Course Name: Bioprocess Engineering Lab

b) Course Code: 03630210

c) Prerequisite: Basic knowledge of Biotechnology, basic maths, physics and fluid mechanics.

d) Rationale: This course will enable the students to learn practical skills in the domain of bioprocess engineering

e) Course Learning Objective

CLOBJ 1	To predict the kinetics of cell and enzymatic reactions for bioprocess optimization.
CLOBJ 2	To plan, collect, and analyze experimental data related to biochemical processes and reactor performance.
CLOBJ 3	To calculate design parameters for reaction kinetics and reactor design in bioprocess applications.
CLOBJ 4	To develop kinetic parameters for microbial growth and product formation to enhance process efficiency.
CLOBJ 5	To distinguish between scale-up techniques and the role of instrumentation in fermenter operations.

f) Course Learning Outcomes:

CLO 1	Predict the kinetics of cell and enzymatic reaction.
CLO 2	Planning, collection and analysis of experimental data.
CLO 3	Calculation of design data for the kinetics and reactor design.
CLO 4	Develop the kinetic parameters for microbial growth and product formation.
CLO 5	Distinguish between scale up and instrumentation in fermenters.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) Course Content:

Exp. No.	Name of the Experiment
1.	Layout of a bioreactor.

2.	To develop the growth curve of a bacteria and estimate the specific growth rate and doubling time.
3.	To develop the growth curve of a yeast and estimate the specific growth rate and doubling time.
4.	Comparison between aerobic and anaerobic fermentation.
5.	To calculate the sterilization efficiency of UV rays.
6.	To study the effect of temperature on biomass concentration.
7.	To study the effect of pH on biomass concentration.
8.	To study the effect of different media on biomass concentration.
9.	To study the effect of batch time on biomass concentration.
10.	Industrial bioprocessing and scale-up.

i) Text Book and Reference Book:

1. **Bioprocess Engineering Principles (TextBook)**
By Paulin M Doran | Elsevier science and technology publication | 2nd
2. **Biochemical engineering fundamentals**
By James E Bailey, David F., Ollis, | McGraw Hill Intl. Edition. | 2nd
3. Bioprocess engineering: Basic concepts
By Shuler, M. L., Kargi, F., & DeLisa, M. | Pearson. | 3, Pub. Year 2017

a) **Course Name:** Professional Communication and Critical Thinking

b) **Course Code:** 03693203

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Advance level of communication and personality development is crucial for and after placement.

e) **Course Learning Objective:**

CLOBJ 1	Discover the ability to clearly and confidently articulate ideas and information in various professional settings, including presentations, meetings, and discussions.
CLOBJ 2	Improve skills in writing clear, concise, and professional documents such as reports, emails, proposals, and executive summaries.
CLOBJ 3	Develop the ability to analyze complex problems, identify underlying issues, and evaluate potential solutions using logical reasoning and evidence-based approaches.

f) **Course Learning Outcomes:**

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO2	List of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
CLO 3	Explain skills of group presentation and communication in team.
CLO 4	Develop non-verbal communication such as proper use of body language and gestures.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Story Mason** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	**5**	**1**
2	**Determiners, Articles, and Interrogatives** This session will enable students to understand proper usage of Determiners and Articles. It will also enhance their daily speaking conversational/ communication skills. Preparation of verbal section in company's aptitude exam.	**10**	**2**

3	**Subject-Verb Agreement** This will enable students to understand the formation of sentence with the usage of subject-verb agreement.	**10**	**1**
4	**Reading-Skill Building** Types of Reading – reading for different purposes An Astrologer's Day-Magadi Days Enhance reading skills by collecting information, know the importance of reading.	**10**	**1**
5	**Reading Comprehension** Learn to solve the reading comprehension questions in an easy manner and also in less amount of time Introduction, Factual & Inferential comprehension, Reasons for Poor Comprehension Able to solve reading comprehension in less amount of Time by practicing.	**10**	**2**
6	**Mafia the art of Observation and Convincing** The interesting activity is targeted toward improving observation and convincing skills. A team activity in which every single Individual is a very important person of his team to win.	**5**	**1**
7	**Direct and Indirect Speech** This session will enable students to understand proper usage of narration.	**10**	**1**
8	**Industry Expectation** In this class the students will be made to understand what will be the world after their college life will be, how they should prepare themselves from that competitive world with full of challenges for them.	**5**	**1**
9	**Mirror & Water Images** Reflection of an object into a mirror and water. It is obtained by inverting an object laterally (mirror) & vertically (water).	**10**	**1**
10	**Sentence Correction** It will also enhance their daily speaking conversational/communication skills. Preparation of verbal section in company's aptitude exam.	**5**	**1**
11	**Play Teacher** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	**5**	**1**
12	**Professional Writing** Email and report.	**5**	**1**
13	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	**10**	**1**
	Total	**100**	**15**

i) Text Book and Reference Book:

1. **Active English**
   By Juneja & Qureshi | Macmillan
2. **Verbal and Non-verbal reasoning**
   By B.S. Sijvali and Indu Shivali | Arihant Publication
3. **Competitive English**
   By Azhar Siddiqui | Macmillan

SEMESTER 4

a) Course Name: Essence of Indian Knowledge and Tradition

b) Course Code: 03600251

c) Prerequisite: A basic understanding or interest in philosophical concepts, particularly within the Indian context.

d) Rationale: The course aims at imparting basic principles of thought process, reasoning and inference with respect to Indian Traditional Knowledge Systems.

e) Course Learning Objective

CLOBJ 1	Keen to learn the fundamental principles and concepts of Indian knowledge and tradition, including its philosophical, spiritual, and cultural aspects.
CLOBJ 2	Analyze the historical development and evolution of Indian thought, from ancient Vedic period to modern times, highlighting key figures, texts, and movements.
CLOBJ 3	Importance of Indian knowledge systems to various fields, including science, mathematics, medicine, and the arts.

f) Course Learning Outcomes:

CLO 1	Elaborate the role of Modern Science.
CLO 2	Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**20**	**20**	-	**-**	-	**40**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Basic Structure of Indian Knowledge System** I) Vedas, (ii) Unveda (Ayurveda, Dhanuveda, Gandhveda, Sthanya etc.) (iii) Vedanga (Education, Kalna, Nan rut, Grammar, Jyotish verses), (iv) Upanayana (Dharma level, Viramas, Purana, Takoma level)	**60**	**10**
2	**Modern Science and Indian Knowledge System**	**15**	**2**
3	**Yoga and Holistic Health care**	**15**	**1**
4	**Case Studies**	**10**	**2**
	Total	**100**	**15**

a) **Course Name:** Cell Biology

b) **Course Code:** 03630251

c) **Prerequisite:** Basic Concepts of Biology.

d) **Rationale**: It involves various aspects of internal structure of cells and various processes carried out by them.

e) **Course Learning Objective:**

CLOBJ 1	To develop a fundamental understanding of the differences between prokaryotic and eukaryotic cells.
CLOBJ 2	To compare prokaryotic and eukaryotic cells based on the structure and function of their cellular components.
CLOBJ 3	To evaluate various bio-signaling pathways and cellular processes in prokaryotic and eukaryotic systems.
CLOBJ 4	To understand the basic concepts of cellular processes, including cell cycle events and their regulation.
CLOBJ 5	To understand the principles of signal transduction and the organization of signaling networks in cells.

f) **Course Learning Outcomes:**

CLO 1	Developing a fundamental understanding between prokaryotic and eukaryotic cells.
CLO 2	Compare prokaryotic and eukaryotic cells based on structure and function of their cellular components.
CLO 3	Evaluating the different bio signaling pathways and various cell processes.
CLO 4	Understand the basic concept of cellular processes and cell cycle events.
CLO 5	Understand the basics of signal transduction and signaling networks

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction to Cells** Introduction to Akaryotic, Prokaryotic and Eukaryotic Cells. Structure of Prokaryotic and Eukaryotic Cells. Origin and evolution of cell.	**20**	**10**
2	**Cell Biology of Prokaryotes** Cellular components of prokaryotic organisms – Cell wall, Cell membrane, Outer Membrane, Cytoplasm, Gas vesicle, Endospore, Plasmid, Nucleoid, Mesosome, Ribosome, Flagella, Slime layer/Capsule - structure, function and integration..	**25**	**10**
3	**Cell Biology of Eukaryotes** Cellular components of eukaryotic organisms - Cell Wall, Cell membrane, Cytoplasm, Endoplasmic Reticulum, Ribosome, Lysosome, Golgi Apparatus, Microbodies, Mitochondria, Plastids, Nucleus, Chromosome, Cytoskeleton, Centrioles and Basal bodies, structure, function and integration.	**25**	**10**
4	**Cellular Processes** Cell Interactions: Adhesion Junctions, Tight Junctions Gap Junctions, Plasmodesmata Cell Signalling: Signaling Molecules and Their Receptors, Modes of Cell-Cell Signaling, Fundions of Cell Surface Receptors, Pathways of Intracellular Signal Transdudion, Signaling Networks. Cell cycle: Eukaryotic cell cycle, Phases of the cell cycle, Regulation of the cell cycle by cell growth and extracellular signals, Cell cycle checkpoints, Regulators of cell cycle progression, DNA damage checkpoints, Events of M phase Cell Death: The Events of Apoptosis, Caspases, Central regulator of Apoptosis, Signalling pathways to regulate apoptosis. Cell Renewal: Stem Cells and the Maintenance of Adult Tissues, Reprogramming and Growth factors.	**30**	**15**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (TextBook)**
By P.S.Verma and V. K. Agarwal | Chand (S.) & Co Ltd, India | 1st
2. **The Cell: a Molecular Approach**
By Cooper, G. M., & Hausman, R. E. | Washington: ASM; Sunderland, Pub. Year 2009
3. Cell and Molecular Biology
By De Robertis, E.D.P | Lippincott Williams and Williams(eighth Edition)

a) **Course Name:** Analytical Instruments for Biotechnology

b) **Course Code:** 03630253

c) **Prerequisite:** Basic Concepts of instrumentation system.

d) **Rationale**: It involves knowledge of scientific understanding of the basic concepts in instrumentation used in Biotechnology.

e) **Course Learning Objective:**

CLOBJ 1	To understand the fundamental concepts of spectroscopic techniques and their applications in biotechnology.
CLOBJ 2	To provide knowledge of spectroscopic and diffraction-related techniques for analyzing biological samples.
CLOBJ 3	To develop practical skills in using microscopic techniques for the visualization of biological structures.
CLOBJ 4	To understand the principles and applications of various chromatography and centrifugation techniques.
CLOBJ 5	To understand the basic concepts and methodologies of different electrophoretic techniques used in biomolecular analysis.

f) **Course Learning Outcomes:**

CLO 1	Understand the basic concepts of spectroscopic techniques used in biotechnology.
CLO 2	Provide the basics of spectroscopic and diffraction related techniques.
CLO 3	Develop skills of microscopic techniques.
CLO 4	Understand the basic concepts of different Chromatography and centrifugation techniques.
CLO 5	Understand the basic concepts of different electrophoretic techniques.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Spectroscopy - I** Introduction to principles and applications of spectroscopic methods - UV-Vis, IR, Fluorescence & CD	**20**	**8**
2	**Spectroscopy** - IIESR, AAS, AFS, AES, Mass spectrometry, NMR, XRD	**20**	**8**
3	**Microscopy Techniques** Bright field and dark field microscopy, phase contrast microscopy, interference microscopy, Fluorescence microscopy, confocal microscopy, electron microscopy - TEM, SEM.	**20**	**10**
4	**Chromatography and Centrifugation Techniques** Chromatography - adsorption, affinity, partition - GLC, HPLC, TLC, HPTLC, RPC. Principle of centrifugation and sedimentation. Types of centrifuges.	**20**	**10**
5	**Electrophoretic Techniques** Electrophoresis of proteins and nucleic acids - 1D & 2D gels, SDS-PAGE, Agarose gel electrophoresis, Western Blotting, Gel documentation.	**20**	**9**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Principles of Instrumental Analysis (TextBook)**
By Skoog DA, Thomspon Brooks and Cole | Harcourt Brace College Publisher | 5th, Pub. Year 1998
2. **Instrumental Methods of Chemical Analysis**
By Chatwal GR | Himalaya Publishing House | 5th, Pub. Year 1998
3. **Instrumental Methods of Chemical Analysis**
By Sharma BK | Krishna Prakashan Media Pvt Ltd | 5th, Pub. Year 1994
4. **Principles and techniques of Biochemistry and Molecular Biology (TextBook)**
By Keith Wilson and John Walker
5.**Instrumental Methods of Analysis**
By Willard, Merritt, Dean, Settle, | CBS Publishers & Distributors, New Delhi, Seventh edition.

a) Course Name: Analytical Instruments for Biotechnology Lab

b) Course Code: 03630254

c) Prerequisite: Knowledge of molecular biology and biochemistry

d) Rationale: Introducing the fundamentals of various analytical techniques in biotechnology laboratory.

e) Course Learning Objective

CLOBJ 1	To understand and effectively use various standard laboratory procedures in biotechnology experiments.
CLOBJ 2	To understand the working principle and applications of UV-visible spectrophotometry in analyzing biological samples.
CLOBJ 3	To understand the working principle and applications of centrifugation techniques for separating biological components.
CLOBJ 4	To understand the working principle and applications of a microscope for visualizing cellular and molecular structures.
CLOBJ 5	To understand the working principle and applications of different electrophoresis techniques for biomolecule analysis.

f) Course Learning Outcomes:

CLO 1	Understand and use the various standard laboratory procedures.
CLO 2	Understand the working principle and applications of UV-visible Spectrophotometer.
CLO 3	Understand the working principle and applications of centrifugation.
CLO 4	Understand the working principle and application of a microscope.
CLO 5	Understand the working principle and application of a different electrophoresis techniques.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Exp. No.	**Name of the Experiment**
1.	Preparation of molar and normal solution.

2.	Measuring of pH of given solution through pH meter.
3.	To study of Beer's Lamberts Law.
4.	To perform the paper chromatography.
5.	To demonstrate High Performance Liquid Chromatography.
6.	To demonstrate the Western Blotting.
7.	To demonstrate the SDS-PAGE.
8.	To demonstrate microscopy and slide preparation.
9.	Demonstration of agarose gel electrophoresis.
10.	Demonstration of column chromatography.

i) Text Book and Reference Book:

1. **Principles of Instrumental Analysis (TextBook)**
By Skoog DA, Thomspon Brooks and Cole | Harcourt Brace College Publisher | 5th, Pub. Year 1998
2. **Instrumental Methods of Chemical Analysis**
By Chatwal GR | Himalaya Publishing House | 5th, Pub. Year 1998
3. **Instrumental Methods of Chemical Analysis**
By Sharma BK | Krishna Prakashan Media Pvt Ltd | 5th, Pub. Year 1994
4. **Principles and techniques of Biochemistry and Molecular Biology (TextBook)**
By Keith Wilson and John Walker
5.**Instrumental Methods of Analysis**
By Willard, Merritt, Dean, Settle, | CBS Publishers & Distributors, New Delhi, Seventh edition.

a) **Course Name:** Fundamentals of Process Engineering

b) **Course Code:** 03630255

c) **Prerequisite:** Basic concepts of mathematics and physics.

d) **Rationale**: It involves knowledge of the heat transfer, which is one of the important transfer process in engineering field.

e) **Course Learning Objective:**

CLOBJ 1	To utilize technological methods related to heat transfer and fluid flow operations in biotechnological processes for efficient system design.
CLOBJ 2	To summarize the challenges and considerations in heat transfer equipment and fluid flow operations during the preliminary stages of design.
CLOBJ 3	To identify the significance of incompressible fluid flow in biotechnological applications and its role in process optimization.
CLOBJ 4	To understand the basic concepts of fluid transportation through various devices such as pumps, pipelines, and valves.
CLOBJ 5	To understand the principles of momentum transfer and its applications in biotechnological systems.

f) **Course Learning Outcomes:**

CLO 1	Utilize the technological methods related to heat transfer and fluid flow operations in biotechnological process.
CLO 2	Summarize the heat transfer equipment and fluid flow operations problems associated at preliminary stage of design.
CLO 3	Identify the importance of incompressible fluid flow in biotechnology.
CLO 4	Understand basic concept of transportation of fluids through different devices.
CLO 5	Understand the momentum transfer in biotechnology

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Modes of Heat Transfer** Introduction to three modes of heat transfer: Conduction - Fourier's law of conduction, Application of Fourier's law for plane wall, composite wall, cylinder, sphere, etc., Heat transfer in case of simultaneous conduction &convection for plane wall & cylinder, unsteady state heat conduction, Concept of critical thickness of insulation. Convection- Natural convection & forced convection, Empirical equation forindividual coefficients, significance of Prandtl No., Grashoff no., Nusselt no, peclet no. Radiation - Wave and Quantum theory of radiation heat transfer, Black body, Gray body, Transmissivity, Absorrtivity, Reflectivity, Emissivity, Derivation of Stefan Boltsmanns law, Wiens law, Kirchoff's law.	**35**	**12**
2	**Heat Exchangers** Types of heat exchanger's, LMTD, Heat transfer area requirement, Overall heat transfer coefficient.	**10**	**7**
3	**Flow of Incompressible Fluid** Flow between two plates and pipes, Mass velocity, Average velocity, potential flow, Streamlines etc. Equation of Continuity, Bernoulli's equation and its applications.	**25**	**12**
4	**Flow Passed Bodies** Drag Force, Fluidization. Transportation of Fluids - Pumps, Valves, Metering devices.	**15**	**7**
5	**Momentum Transfer in Biotechnology** Rheological Behavior of fermentation broth, two- parameter, three parameter models.	**15**	**7**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Bioprocess Engineering Principles (TextBook)**
By Paulin M Doran | Elsevier science and technology publication | 2nd
2. **Bioprocess Engineering – Basic Concepts",**
By Shuler M.L. and Kargi F | Prentice-Hall of India, New Delhi, | 2nd Edition, Pub. Year 2006
3. **Heat Transfer**
By Donald Q Kern | McGraw Hill

a) **Course Name:** Basics of Food Processing

b) **Course Code:** 03630257

c) **Prerequisite:** Basic concepts of mathematics and physics.

d) **Rationale**: It involves knowledge of different food processing and preservation techniques.

e) **Course Learning Objective:**

CLOBJ 1	To summarize the various constituents present in food and the energy associated with them.
CLOBJ 2	To understand the roles and applications of different food additives in enhancing food quality and preservation.
CLOBJ 3	To understand the involvement of different microorganisms in food processing and their impact on food safety and quality.
CLOBJ 4	To understand the concept of foodborne diseases, including their causes, prevention, and control measures.
CLOBJ 5	To identify modern techniques used in food processing and preservation for maintaining nutritional value and extending shelf life.

f) **Course Learning Outcomes:**

CLO 1	Summarizing about different constituents present in the food and energy associated.
CLO 2	Understand the concept of different food additives.
CLO 3	Understand the different microorganisms involved in food processing.
CLO 4	Understand the concept of food borne diseases.
CLO 5	Identifying different techniques involved in modern food processing and preserving.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) **Course Content:**

Sr.	**Content**	**Weightage (%)**	**Teaching hours**

1	**Food and energy** Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.	**20**	**8**
2	**Food additives** Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.	**20**	**9**
3	**Microorganisms associated with food** Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.	**20**	**6**
4	**Food borne diseases** Classification – food infections – bacterial and other types; food intoxications and poisonings–bacterial and nonbacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.	**20**	**10**
5	**Food preservation** Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.	**20**	**12**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Food Processing And Preservation (TextBook)**

By B. Sivasanker | Prentice-Hall Of India Pvt. Ltd. New Delhi, Pub. Year 2002

2. Food – The Chemistry of Its Components

By T.P. Coultate | Royal Society, London | 2nd, Pub. Year 1992

a) **Course Name:** Basics of Food Processing Lab

b) **Course Code:** 03630258

c) **Prerequisite:** Knowledge of biology

d) **Rationale:** Introducing the basics of food processing laboratory practices.

e) **Course Learning Objective**

CLOBJ 1	To understand and effectively use various standard laboratory procedures in microbiological and food science experiments.
CLOBJ 2	To understand the working principles and applications of autoclaves for sterilization of media and equipment.
CLOBJ 3	To understand the working principles and applications of Laminar Air Flow systems for maintaining aseptic conditions during culturing.
CLOBJ 4	To understand the basic principles and methods of food storage to ensure quality and safety.
CLOBJ 5	To understand the activity and behavior of microorganisms under different temperature conditions and their implications for food preservation.

f) **Course Learning Outcomes:**

CLO 1	Understand and use the various standard laboratory procedures.
CLO 2	Understand the working principle and applications Autoclave and sterilization of media.
CLO 3	Understand the working principle and applications Laminar Air Flow to maintain the aseptic condition while culturing.
CLO 4	Understand the basic principle and methods of food storage.
CLO 5	Understand the activity of microorganisms based on temperature.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1.	Preparation of nutrient media.
2.	Sterilization of media.

3.	Sterilization of glasswares and plasticwares.
4.	Demonstration of fermented food products.
5.	Demonstration of food additives.
6.	To perform addition of natural colors in foods.
7.	To perform centrifugation of milk to get butter.
8.	To perform spoilage of fruits.
9.	Demonstration of food preservatives.
10.	To perform microbial activity based on temperature.

j) Text Book and Reference Book:

1. **Food Processing And Preservation (TextBook)**
By B. Sivasanker | Prentice-Hall Of India Pvt. Ltd. New Delhi, Pub. Year 2002

2. Food – The Chemistry of Its Components
By T.P. Coultate | Royal Society, London | 2nd, Pub. Year 1992

a) **Course Name:** Life science-II

b) **Course Code:** 03630259

c) **Prerequisite:** Basic Concepts of Human Body Organization

d) **Rationale**: The students need to learn fundamentals of anatomical structures and physiology of body organs.

e) **Course Learning Objective:**

CLOBJ 1	To explain the structures of different body parts and their roles in maintaining overall functionality.
CLOBJ 2	To describe the physiological processes and functions of various body organs.
CLOBJ 3	To explain the mechanisms underlying the functioning of different body systems.
CLOBJ 4	To describe the structure and functions of blood and blood vessels in the circulatory system.
CLOBJ 5	To understand the interrelationship and coordination of various body systems in sustaining life processes.

f) **Course Learning Outcomes:**

CLO 1	Explain the structures of different body parts.
CLO 2	Describe the physiology of body organs.
CLO 3	Explain the mechanism of system functioning.
CLO 4	Describe the structure and functions of the blood & blood vessel.
CLO 5	Understand the various body systems.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Excretory system** Brief structure of kidney, Size, shape & location of kidney. Blood supply to kidney, nerve supply to the kidney, ureter, bladder, Structure of skin, Function of kidney, urine formation, Concentration and Dilution of Urine, micturition, Renal Function Tests, Dialysis, Artificial Kidney, Function of skin.	**25**	**10**
2	**Digestive System** Size, shape, location various organ of digestive system, organs of digestive system, movement of gastrointestinal tract, mastication, deglutination, physiological activities in mouth, pharynx, esophagus, stomach, pancreas, liver, gall bladder, small and large intestine, Digestion and absorption.	**25**	**10**
3	**Nervous System** Outline of Cranial and Spinal nerves. Structure of Spinal Cord and different Brain parts. Vertebral column and cranial cavity, Neuron, Neuroglial cell, Synapse, Receptors, Sensory tract, motor tract, reflex arc, EEG.	**20**	**10**
4	**Reproductive System** Male reproductive organs, female reproductive organs, Spermatogenesis; Ovarian cycle physiology. Physiology of menstruation, Pregnancy and Contraception.	**10**	**10**
5	**Endocrine system** Endocrine glands, physiological action of the hormones secreted by pituitary, thyroid, parathyroid, islets of Langerhans, adrenal, testes, ovaries, biofeedback mechanism of hormone regulation.	**8**	**10**
6	**Special Senses** a) Vision: structure of Eye, optic nerve, Mechanism of accommodation, Visual acuity, Ophthalmoscope, Colour vision, Perimetry. b) Hearing: structure of ear, Tympanic membrane, cochlea, Hearing mechanics and abnormality, Deafness, Audiometry. c) Nose: sense of smell d) Tongue: sense of taste	**12**	**10**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Anatomy and Physiology in Health and Illness**
By Ross and Wilson | ELBS Pub
2. **Essential of medical physiology (TextBook)**
By Indu khurana
3. **General Anatomy**
By B.D. Chaurasia

4. **Physiology of Human Body**
By Guyton
5. **Principles of General Anatomy**
By A.K.Datta

a) **Course Name:** Employability Skills

b) **Course Code:** 03693251

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Cracking aptitude is the first step towards cracking placements and competitive exams

e) **Course Learning Objective**

CLOBJ 1	Develop effective verbal, non-verbal, and written communication skills for professional settings.
CLOBJ 2	Analyze the ability to contribute effectively to group projects and resolve conflicts in a constructive manner.
CLOBJ 3	Function critical thinking and decision-making skills through real-life case studies and simulations.

f) **Course Learning Outcomes:**

CLO 1	Improve their critical thinking.
CLO 2	Prepares them for Campus Placement & Competitive Exams.
CLO 3	Builds up their confidence level.

g) **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	-	1	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching Hours
1	**Critical Thinking - Case Studies** Critical thinking is based on pure logical thinking. Solving a critical reasoning question requires nothing but reasoning ability of the candidate. This session deals with the basic logic involved in critical reasoning questions and covers all the type of questions in CT. Worksheets would be provided to students for further practice.	8	2
2	**Coding & Decoding, Alphabetical Series** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above- mentioned topics.	8	1
3	**Analogy and Odd Man Out** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above-mentioned topics.	8	1
4	**Direction Sense** Able to solve all the direction sense question in competitive exams and aptitude exams of different Companies.	8	1

5	**Blood Relations** Able to solve all the Blood Relation questions in competitive exams and aptitude exams of different companies.	**8**	**1**
6	**Paper Folding** In this section of nonverbal reasoning a figure is obtained by folding a piece of paper containing same design along the dotted line.	**6**	**1**
7	**Seating Arrangement** Candidates are required to arrange the objects either in a row or circle on the basis of information. Questions are presented in distorted form to create confusion and to taste the candidate's ability to analyze the information step by step in order to answer the question.	**8**	**1**
8	**Completion of Figure** In each of the following figure, a part of figure is missing. Find out from the given options, the right figure to fit in the missing figure.	**6**	**1**
9	**Completion of Series** In these questions a series of figures is given as problem figure & the candidate are asked to select one of the figures from the set of answer figure which will continue the given sequence.	**8**	**2**
10	**Entrepreneurship Skills (Selling the Concept)** This topic will help students develop the skills necessary to develop into Self- Sufficient business leaders through Entrepreneurship studies.	**8**	**1**
11	**Resume Building** The students will have a proper understanding of the content and how it is to be presented in resume.	**8**	**1**
12	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	**8**	**1**
13	**Interview Skills** Students are prepared for their interviews, question and answers, how to react on some unique	**8**	**1**
	Total	**100**	**15**

i) Text Book and Reference Book:

1. **Non-Verbal Reasoning**
   By B S Sewali and Indu Sewali | Arihant
2. **Develop Your Contributor Personality**
   I-become Publishers, Mumbai

SEMESTER – 5

a) Course Name: Biochemistry

b) Course Code: 03630301

c) Prerequisite: Knowledge of basic biology and chemistry

d) Rationale: To provide an understanding of the structure and functions of various bio molecules and their metabolism.

e) Course Learning Objective:

CLOBJ 1	To familiarize students with the classification, structural, and functional properties of carbohydrates.
CLOBJ 2	To understand the classification and functional properties of fats and lipids in biological systems.
CLOBJ 3	To acquire knowledge about the structural and functional properties of amino acids and proteins.
CLOBJ 4	To gain knowledge about the structural and functional properties of vitamins and minerals essential for health.
CLOBJ 5	To understand the classification of enzymes and hormones and their mechanisms of action in biological processes.

f) Course Learning Outcomes:

CLO 1	Familiar with the classification, structural and functional properties of carbohydrate
CLO 2	Understand the classification and functional properties of fat/lipids.
CLO 3	Knowledge about structural and functional properties of amino acids and proteins.
CLO 4	Knowledge about structural and functional properties of vitamins & minerals.
CLO 5	Understand the classification of enzymes & hormones & their mechanism

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Carbohydrate** Classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and autorotation, stereo isomers and structural isomers.	**20**	**12**
2	**Fats or Lipids** Classification and function: Simple, Compound & Derived lipids, Essential fatty acids.	**15**	**12**
3	**Amino acids and Proteins** Structure & Classification of amino acids. Essential and non-essential amino acids. Peptide bond formation, primary, secondary, tertiary & quaternary structure of proteins.	**25**	**12**
4	**Vitamins and Minerals** Classification of different types of vitamins & minerals, diseases associated with different vitamins.	**15**	**12**
5	**Enzymes and Hormones** Classification of different types of enzymes, enzyme activity, Michalis menten kinetics. Types of hormones and their mechanism.	**25**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Biochemistry (TextBook)**
By U. Satyanarayana& U. Chakrapani
2. **Lehninger's Principles of Biochemistry**
By Nelson, David and Cox., Macmillan NY
3. **Biochemistry**
By Voet and Voet | John Wiley and Sons

a) **Course Name:** Biochemistry Lab

b) **Course Code:** 03630302

c) **Prerequisite:** Knowledge of basic biology and chemistry.

d) **Rationale:** To provide an understanding about different types of biomolecules & correlate them with the scientific research.

e) **Course Learning Objective:**

CLOBJ 1	To learn the procedures for preparing various types of solutions, including molar, and percentage solutions.
CLOBJ 2	To understand the principles of buffer solutions and their role in maintaining pH, and to be able to analyze and predict pH changes in buffer systems.
CLOBJ 3	To master the techniques for isolating plasma and serum from blood samples, including proper collection, handling, and processing procedures.
CLOBJ 4	To develop the ability to perform quantitative analyses of proteins, lipids, and carbohydrates using established laboratory methods.
CLOBJ 5	To gain knowledge of the qualitative tests used to identify and characterize different types of lipids, carbohydrates, and proteins.

f) **Course Learning Outcomes:**

CLO 1	Learn the preparation of different types of solutions.
CLO 2	Learn the preparation of buffer solutions and analysis of pH.
CLO 3	Learn the technique to isolate the plasma and serum from the blood sample.
CLO 4	Understand the quantitative analysis of proteins, lipids and carbohydrates.
CLO 5	Knowledge about qualitative analysis of lipids, carbohydrates and proteins.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination.

h) Course Content:

Sr. NO.	Name of Experiment
1	Preparation of solutions: % solution, molarity & molality.
2	Preparation of buffer & check the pH.
3	To perform isolation of plasma and serum from blood samples.
4	Quantitative test for carbohydrate.
5	Quantitative Estimation of protein.
6	Qualitative detection of glucose in urine.
7	To determine the iodine value of fats and oils.
8	Isoelectric precipitation.
9	Qualitative analysis of lipids solubility test.
10	To perform thin layer chromatography of amino acids.

i) Text Book and Reference Book:

1. **Lehninger Principles of Biochemistry,**
By David L. Nelson, Michael M. Cox, | Publisher: W. H. Freeman | Fourth Edition
2. **Biochemistry**
By U. Satyanarayana & U. Chakrapani

a) Course Name: Bioinformatics

b) Course Code: 03630303

c) Prerequisite: Basic knowledge of Molecular Biology, Mathematics and Computer.

d) Rationale: This course introduces the concept and applications of bioinformatics.

e) Course Learning Objective:

CLOBJ 1	To gain a comprehensive understanding of the fundamental concepts and applications of Bioinformatics, including the various types of biological databases available.
CLOBJ 2	To develop the ability to effectively utilize sequence alignment techniques and perform database searches to identify homologous sequences and analyze their relationships.
CLOBJ 3	To understand the principles of sequence similarity and how they are used to infer evolutionary relationships and functional predictions.
CLOBJ 4	To acquire knowledge of the basic principles of phylogenetic tree analysis and be able to interpret phylogenetic trees to understand evolutionary relationships among organisms.
CLOBJ 5	To learn and apply methods for protein structure identification and prediction using different techniques.

f) Course Learning Outcomes:

CLO 1	To understand the basic concept and application of Bioinformatics, types of databases.
CLO 2	To understand the appropriate use of sequence alignment techniques, database searching.
CLO 3	To understand the basic principles of sequence similarity.
CLO 4	To understand the basic idea of phylogenetic tree analysis.
CLO 5	To apply the protein structure identification and prediction.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction to Bioinformatics** Biological databases: Nucleotide databases, Protein databases, Various file formats for biomolecular sequences: Genbank, EMBL, FASTA.	**20**	**12**
2	**Sequence Alignment and Database Searching** Database similarity searching: FASTA, BLAST, Various versions of basic BLAST and FASTA, Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment.	**20**	**12**
3	**Basic Concepts of Sequence Similarity** Sequence similarity, Identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles.	**15**	**12**
4	**Phylogenetic Tree Analysis** Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees.	**20**	**12**
5	**Protein Identification and Prediction** Protein identification based on composition, Secondary and tertiary structure prediction of proteins, Homology modelling.	**25**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Bioinformatics-Sequence and genome analysis (TextBook)**
By D.W.Mount | Cold Spring HarbourLab press, Pub. Year 2001
2. **Bioinformatics: Concept and application**
By B.N.Mishra | Pearson Education
3. **Developing Bioinformatics computer skills**
By O' Reilly | SPD publication | 1st Indian, Pub. Year 2001

a) Course Name: Bioinformatics Lab

b) Course Code: 03630304

c) Prerequisite: Basic knowledge of Molecular Biology, Mathematics and Computer.

d) Rationale: This course introduces the concept, applications and hands on training of basics of bioinformatics.

e) Course Learning Objective:

CLOBJ 1	To develop the ability to efficiently retrieve nucleotide and protein sequences from major biological databases such as NCBI and UniProt.
CLOBJ 2	To learn the effective use of the Entrez system to search and retrieve relevant biological data from a wide range of databases.
CLOBJ 3	To understand the principles and applications of multiple sequence alignment techniques and their importance in bioinformatics research.
CLOBJ 4	To gain a comprehensive understanding of phylogenetic tree analysis, including its principles, methods, and applications in evolutionary biology and systematics.
CLOBJ 5	To acquire fundamental knowledge of protein structure prediction methods and their significance in understanding protein function and developing new drugs.

f) Course Learning Outcomes:

CLO 1	To learn the retrieval of nucleotide and protein sequences from NCBI/Uniprot.
CLO 2	To learn the retrieval of sequences from Entrez.
CLO 3	To understand the concept of multiple sequence alignment.
CLO 4	To understand the use of phylogenetic tree analysis.
CLO 5	To understand the basic concepts of protein structure prediction.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination.

h) Course Content:

Sr. NO.	Name of Experiment
1	Retrieval of nucleotide sequence data from NCBI.
2	Retrieval of protein sequence data from NCBI/Uniprot.
3	Retrieval of sequence data from Entrez.
4	To perform the multiple sequence alignment.
5	To perform the pairwise alignment.
6	To perform the global alignment.
7	To perform the BLAST for protein sequences.
8	To perform the phylogenetic tree analysis.
9	To perform the secondary structure prediction of proteins.
10	To perform the homology modelling for protein structure prediction.

i) Text Book and Reference Book:

1. **Bioinformatics: Concept and application**
By B.N.Mishra | Pearson Education
2. **Bioinformatics sequence and genome analysis**
By DAVID W MOUNT | Cold spring harbor laboratory press
3. **Developing Bioinformatics computer skills**
By O' Reilly | SPD publication | 1st Indian, Pub. Year 2001

a) **Course Name:** Environmental Biotechnology

b) **Course Code:** 03630305

c) **Prerequisite:** Basic knowledge of environment.

d) **Rationale**: This course will enable the students to learn about the basic concepts of environment biotechnology.

e) **Course Learning Objective:**

CLOBJ 1	To gain a comprehensive understanding of the Earth's climate system, the role of greenhouse gases, and the phenomenon of global warming.
CLOBJ 2	To develop an understanding of the principles and processes involved in the aerobic treatment of water and wastewater.
CLOBJ 3	To understand the concepts and mechanisms of anaerobic treatment of water and wastewater, including its advantages and limitations.
CLOBJ 4	To acquire knowledge of the biodegradation processes of toxic macromolecules and their environmental implications.
CLOBJ 5	To gain a complete understanding of solid waste management, including waste generation, collection, transportation, treatment, and disposal methods.

f) **Course Learning Outcomes:**

CLO 1	Imparts the knowledge of Climate system, Greenhouse gases and Global warming
CLO 2	Students will get an insight of aerobic treatment of water.
CLO 3	Understanding of anaerobic treatment of water.
CLO 4	Understanding of Biodegradation of toxic macromolecules.
CLO 5	Get full idea of solid waste management.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Content	Weightage (%)	Teaching hours
1	**Global Issues** Climate system, Greenhouse gases and their sources, Ozone, Effects of industrial activity- acid rain, smog, Global warming and eutrophication, Radiation hazards.	**10**	**7**
2	**Aerobic Treatment of Water** Nature of water pollutants,BOD, COD, TOC, ThOD,Preliminary and primary treatments, Secondary treatment, Aerobic lagoons or ponds,Trickling filters,Activated sludge process, Fluidized bed.	**15**	**8**
3	**Anaerobic Treatment of Water** Anaerobic treatment - Anaerobic ponds, anaerobic reactors, Anaerobic treatment – UASB, Tertiary treatment suspended solids removal, oil and grease, Biological nitrogen removal nitrification and denitrification , Biological phosphorus removal.	**25**	**10**
4	**Biodegradation** Biodegradation of macromolecules,Genobiotics, Bioremediation of metal contaminated soils, Spilled oil and grease deposits, Synthetic pesticides, Phytotechnology-terrestrial phytosystems, Metal phytoremediation, Phytotechnology-aquatic photosystems, Algal treatment system**.**	**25**	**10**
5	**Solid Waste Management** Sources, generation, classification and composition of solid wastes, Solid waste management methods- Sanitary land filling, Recycling, composting, Solid waste management methods Incineration, energy recovery from organic waste,Waste minimization technologies,Hazardous Waste Management, Sources & Classification, physicochemical properties,Hazardous Waste Control & Treatment, Hospital Waste Management.	**25**	**10**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Environmental Biotechnology**
By Alan Scragg | Oxford University Press Inc, Pub. Year 2007
2. **Environmental Biotechnology (TextBook)**
By P. R. Yadav, and Rajiv Tyagi | Discovery Publishing house, Pub. Year 2006
3. **Environmental Biotechnology- Basic concepts and application (TextBook)**
By Indu Shekhar Thakur | I.K International, Pvt. Ltd, Pub. Year 2006
4. **Environmental Biotechnology**
By Bimal C. Bhattacharyya and B. Rintu, | Oxford University Press Inc, Pub. Year 2007

SEMESTER – 6

a) Course Name: Plant Tissue Culture

b) Course Code: 03630351

c) Prerequisite: Basic knowledge of biology & molecular biology.

d) Rationale: This course will provide an insight about the basic knowledge about plant tissue culture.

e) Course Learning Objective:

CLOBJ 1	To understand the fundamental principles and essential requirements for successful plant tissue culture, including sterilization techniques and aseptic conditions.
CLOBJ 2	To gain a comprehensive understanding of the basic components and their roles in formulating media for plant tissue culture, including macronutrients, micronutrients, vitamins, and growth regulators.
CLOBJ 3	To acquire knowledge about various plant tissue culture techniques, such as organogenesis, somatic embryogenesis, and protoplast culture.
CLOBJ 4	To understand the significance and applications of micropropagation in plant biotechnology, including clonal propagation, germplasm conservation, and production of disease-free plants.
CLOBJ 5	To gain knowledge about different types of transgenic plants, their development through genetic engineering techniques, and their potential applications in agriculture and biotechnology.

f) Course Learning Outcomes:

CLO 1	Understand the principle and basic requirements for plant tissue culture.
CLO 2	Understand the basic media composition required for plant tissue culture
CLO 3	Gain knowledge about the different culturing techniques.
CLO 4	Understand the role of micropropagation.
CLO 5	Gain knowledge about different transgenic plants

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction to Plant Tissue Culture** Terms and definitions, Historical background, Laboratory organization, Tools and techniques, methods of sterilization. Laboratory contaminants- it's control and measures.	**15**	**12**
2	**Media and Culture Preparation** Role of Micro and macro nutrients, Vitamins and carbon source in tissue culture, Media preparation- pH, Temprature, Solidifying agents, Slant Preparations etc. Maintenance of cultures, Environmental Conditions, explants characteristics.	**25**	**12**
3	**Culture Techniques** Explants selection, sterilization and inoculation; Various media preparations; MS, B5, SH PC L-2; Callus and cell suspension culture.	**25**	**12**
4	**Initiation of Cultures** Induction and growth parameters; Culture initiation, Micropropagation through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills).	**15**	**12**
5	**Transgenic Plants for Crop Improvement** Dicot and Monocot plants- Maize, Rice, Wheat, Cotton, Brinjal, Resistance to herbicide, insecticide, virus and other diseases, Flaour save tomato etc. barnase and barstar). Transgenic plants for molecular farming.	**20**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Plant Tissue Culture: Theory and Practice (TextBook)**
By S.S. Bhojwani, M.K. Razdan | Elsevier Science
2. **Plant Biotechnology: The Genetic manipulation of plants(2nd edition),**
By Slater, A, Scott, N, Fowler, M. | Oxford University Press, Pub. Year 2008
3. **Plant Biotechnology**
By H.S. Chawla | Oxford & IBH Publishing
4. **Handbook of Plant Cell Culture (TextBook)**
By Amritrao, P.V.D.A. Evans, W.P.Sharp and Bajaj Y.P.S. | McGraw Hill Publishing Co.,New York | volumes I-V, Pub. Year 1990

a) Course Name: Plant Tissue Culture Lab

b) Course Code: 03630352

c) Prerequisite: Basic knowledge about biochemistry, molecular biology & biology.

d) Rationale: This course will provide the practical knowledge on plant tissue culture techniques.

e) Course Learning Objective:

CLOBJ 1	To develop the practical skills necessary to operate and handle common laboratory equipment used in plant biotechnology research.
CLOBJ 2	To acquire the practical skills to prepare and sterilize tissue culture media and to select and prepare plant explants for in vitro culture.
CLOBJ 3	To understand the principles and techniques of in vitro plant propagation through axillary bud induction.
CLOBJ 4	To understand the role and effects of different plant growth regulators on seed germination and seedling development.
CLOBJ 5	To develop the practical skills to isolate DNA and RNA from plant tissues using standard laboratory procedures.

f) Course Learning Outcomes:

CLO 1	Operate and handle the plant biotechnology lab equipment's.
CLO 2	Perform tissue culture media preparation, sterilization and explants selection.
CLO 3	Understand in vitro cultures through axillary bud induction.
CLO 4	Understand the basic concepts of growth regulators on seed germination.
CLO 5	Perform the isolation of DNA and RNA from plant.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester valuation, **E-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Experiment
1	Preparation of Stock solution & Tissue Culture Media.
2	Sterilization of Explants.
3	Preparation of callus from various explants.
4	Plant propagation from callus.
5	Shoot tip, auxillary bud, Meristem culture.
6	Effect of Auxins and Gibberllins on seed germination.
7	Isolation of DNA and RNA from Plants.
8	Demonstration of Agrobacterium mediated gene transfer.
9	Demonstration of Somatic embryogenesis.
10	Demonstration of protoplast fusion.

i) Text Book and Reference Book:

1. **Plant Tissue Culture: Theory and Practice (TextBook)**
By S.S. Bhojwani, M.K. Razdan | Elsevier Science
2. **Plant Biotechnology: The Genetic manipulation of plants(2nd edition),**
By Slater, A, Scott, N, Fowler, M. | Oxford University Press, Pub. Year 2008
3. **Plant Biotechnology**
By H.S. Chawla | Oxford & IBH Publishing
4. **Handbook of Plant Cell Culture (TextBook)**
By Amritrao, P.V.D.A. Evans, W.P.Sharp and Bajaj Y.P.S. | McGraw Hill Publishing Co.,New York | volumes I-V, Pub. Year 1990

a) Course Name: Genetic Engineering

b) Course Code: 03630353

c) Prerequisite: Basic knowledge of molecular biology.

d) Rationale: This course introduces the concept and applications of genetic engineering.

e) Course Learning Objective:

CLOBJ 1	To gain a comprehensive understanding of the fundamental concepts of restriction enzymes, their properties, and their role in genetic manipulation techniques.
CLOBJ 2	To understand the principles of selecting appropriate host organisms and vectors for gene cloning and recombinant DNA technology, considering factors such as host-vector compatibility and desired gene expression.
CLOBJ 3	To understand the basic principles and techniques of gene amplification (e.g., PCR) and DNA sequencing, and their applications in molecular biology research.
CLOBJ 4	To understand the application of molecular markers, such as SNPs and RFLPs, in the identification and diagnosis of genetic diseases.
CLOBJ 5	To understand the diverse applications of genetic engineering in various fields, including agriculture, medicine, biotechnology, and environmental science.

f) Course Learning Outcomes:

CLO 1	Understand the basic concept of restriction enzymes and genetic manipulation.
CLO 2	Understand the appropriate use of host and vector for gene cloning and r-DNA technology.
CLO 3	Understand the basic concepts of gene amplification and sequencing of a gene.
CLO 4	Use of molecular markers for disease identification.
CLO 5	Understand the different applications of genetic engineering.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Manipulation of DNA** Restriction Modification system, DNA manipulative enzymes, Restriction Enzymes and its types, Isoschizomers, Neoschizomers, DNA ligases and its applications.	**20**	**12**
2	**Gene Cloning and Recombinant DNA Technology** Basic steps of gene cloning, Cloning and expression vectors, Plasmid and Bacteriophage vectors, Artificial Chromosomes, (BAC and YAC), Applications of Gene Cloning.	**20**	**12**
3	**Polymerase Chain Reaction and DNA Sequencing** Basic Concepts of PCR , PCR types (RT-PCR, Real Time PCR, Hot Start PCR, Allele Specific PCR, Inverse PCR, Nested PCR), Maxam and Gilbert Sequencing, Sanger Sequencing, Next Generation Sequencing. Applications of PCR and DNA Sequencing.	**30**	**14**
4	**Molecular Markers and its Applications** Introduction of Molecular Markers, Types of molecular markers and its applications: RAPD, RFLP, AFLP, SNP.	**15**	**10**
5	**Applications of Genetic Engineering** Application of genetic engineering in the production of transgenic animals, bacteria and plants, Gene therapy, DNA Drugs and Vaccines. Case studies on different applications of genetic engineering.	**15**	**12**
Total		**100**	**60**

i) Text Book and Reference Book:

1. **Gene Cloning and DNA Analysis (TextBook)**
By BROWN, T.A | Black Well Science | 4th, Pub. Year 2001
2. **Molecular Biology of the Cell**
By Bruce Alberts | Garland Science Publishers | 4th
3. **Molecular Cloning: A Laboratory Manual (3- Volume Set)**
By Sambrook J. et al.
4. **Molecular biotechnology (TextBook)**
By S.B Primrose | Anima Publishing Corporation | 2, Pub. Year 2001
5. **Genetic Engineering**
By Dr Smita Rastogi & Dr Neelam Pathak | Oxford University Press | Illustrated, Pub. Year 2009

a) Course Name: Genetic Engineering Lab

b) Course Code: 03630354

c) Prerequisite: Basic knowledge of molecular biology.

d) Rationale: This course introduces methods to isolate the biomolecules from cells and genetic engineering techniques.

e) Course Learning Objective:

CLOBJ 1	To understand and be able to perform the techniques for isolating plasmid DNA and genomic DNA from various biological sources.
CLOBJ 2	To interpret the results of DNA quantification methods and understand the importance of accurate DNA quantification in molecular biology experiments.
CLOBJ 3	To develop the skills to purify DNA samples isolated from different sources using appropriate techniques to remove contaminants and obtain high-quality DNA.
CLOBJ 4	To understand the principles and applications of restriction enzymes in genetic manipulation, including their use in gene cloning, DNA mapping, and other molecular biology techniques.
CLOBJ 5	To gain a comprehensive understanding of the basic concepts of gene amplification, including the principles of Polymerase Chain Reaction (PCR) and its various applications.

f) Course Learning Outcomes:

CLO 1	Understand the technique to isolate plasmid and genomic DNA.
CLO 2	Interpret the technique of DNA quantification.
CLO 3	Extend the technique to purify the DNA sample isolated from different source.
CLO 4	Contrast the use of restrictions enzymes for genetic manipulation.
CLO 5	Understand the basic concepts of gene amplification.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**0**	**2**	**1**	**-**	**-**	**20**	**-**	**30**	**50**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester valuation, **E-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Name of the Experiment
1	Isolation of plasmid DNA.
2	Isolation of genomic DNA from blood.
3	Isolation of Yeast genomic DNA.
4	Isolation of genomic DNA from plant cells.
5	Quantification of DNA through spectrophotometer.
6	Estimation of DNA through diphenylamine reaction.
7	Elution of plasmid DNA with the help of agarose gel electrophoresis.
8	Perform the restriction digestion of lambda phage DNA.
9	To perform the PCR for DNA amplification.
10	To demonstrate the Primer Designing.

i) Text Book and Reference Book:

1. **Gene Cloning and DNA Analysis (TextBook)**
By BROWN, T.A | Black Well Science | 4th, Pub. Year 2001
2. **Molecular Cloning: A Laboratory Manual (3- Volume Set)**
By Sambrook J. et al.

a) Course Name: Indian Constitution

b) Course Code: 03600351

c) Prerequisite Understanding the historical context of India's freedom struggle, colonial rule, and the events that led to the drafting of the Constitution.

d) Rationale: The course aims to give brief knowledge of Indian Constitution and administration of different bodies of India.

e) Course Learning Objective:

CLOBJ 1	Analyze the historical circumstances that led to the framing of the Indian Constitution.
CLOBJ 2	Understand and interpret the core values enshrined in the Constitution, including justice, liberty, equality, and fraternity.
CLOBJ 3	Identify and explain the roles, powers, and functioning of the executive, legislature, and judiciary at both Union and State levels.

f) Course Learning Outcomes:

CLO 1	Understanding the Constitution
CLO2	Ability to understand, Union Government State Government, Local Administration and Election Commission

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	0	20	20	-	-	-	40

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teachig Hours
1	**The Constitution – Introduction** The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretationFundamental Rights and Duties and their interpretation, State Policy Principles.	25	8
2	**Union Government** Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha.	20	4
3	**State Government** Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat.	20	4
4	**Local Administration** District Administration, Municipal Corporation, Zila Panchayat.	15	7

5	**Election Commission** Role and Functioning, Chief Election Commissioner, State Election Commission	**20**	**7**
	Total	**100**	**30**

i) Text Book and Reference Book

1. **An Introduction to the Constitution of India**
   By D.D. Basu | Prentice Hall, New Delhi
2. **An Introduction to the Constitution of India**
   By M. V. Pyle | Vikas New Delhi

a) Course Name: Metabolic Engineering

b) Course Code: 03630381

c) Prerequisite: Basic knowledge of biology & biochemistry.

d) Rationale: This course will provide an insight about the metabolic pathways & synthesis of different metabolites.

e) Course Learning Objective:

CLOBJ 1	To explain the fundamental concepts of metabolism, including catabolism, anabolism, and the key pathways involved, and understand the importance of metabolic engineering in optimizing cellular processes for various applications.
CLOBJ 2	To understand the mechanisms of metabolite production in cells, including the regulatory pathways that control metabolic fluxes and enzyme activities.
CLOBJ 3	To explain the applications, specificity, and limitations of bioconversion processes, including product inhibition and its impact on biocatalytic reactions.
CLOBJ 4	To understand the key concepts and principles of synthetic biology, including the design and construction of novel biological systems for specific purposes.
CLOBJ 5	To identify and describe different metabolic pathways involved in the synthesis of important biomolecules, such as amino acids, fatty acids, and secondary metabolites.

f) Course Learning Outcomes:

CLO 1	Explain basic concepts of metabolism and importance of metabolic engineering.
CLO 2	Understand the production of metabolites and its regulatory mechanism.
CLO 3	Explain the applications, specificity and product inhibition of bioconversion.
CLO 4	Understand the concepts of synthetic biology.
CLO 5	Identify the different metabolic pathways and related to important synthesis.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Basic Concept of Metabolism** Anabolism & catabolism, Importance of metabolic engineering General Principles of Intermediary Metabolism, Regulation of Pathways.	**25**	**7**
2	**Synthesis of Primary Metabolites** Amino acid synthesis pathways and its regulation at enzyme level and whole cell level.	**15**	**8**
3	**Biosynthesis of Secondary Metabolites** Regulation of secondary metabolite pathways, precursor effects, producers of secondary metabolites, applications of secondary metabolites.	**15**	**8**
4	**Bioconversions** Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields.	**25**	**9**
5	**Synthetic Biology** Metabolic pathway synthesis, relation with bioprocess design, Introduction to tools of synthetic biology.	**20**	**13**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Principles of Fermentation Technology (TextBook)**
By Stanbury P. F. and Whitaker A. | Pergamon Press, Pub. Year 1984
2. **Metabolic Engineering Principles and Methodologies**
By G. Stephanopoulos, A. Aristidou and J. Nielsen | Academic Press, Pub. Year 1998
3. **Fermentation and Enzyme Technology**
By Daniel I. C. Wang, Malcolm D. Lilly, Arthur E. Humphrey, Peter Dunnill, Arnold l. Demain | John Wiley& Sons | 1st, Pub.Year 2005

a) Course Name: Entrepreneurship in Biotechnology

b) Course Code: 03630383

c) Prerequisite: Basic knowledge of Biotechnology.

d) Rationale: This course introduces the basic concepts on entrepreneurship in biotechnology.

e) Course Learning Objective:

CLOBJ 1	To understand the fundamental concepts of entrepreneurship, including its definition, characteristics of entrepreneurs, and the entrepreneurial process.
CLOBJ 2	To analyze the various avenues for business development in the biotechnology sector, including identifying market opportunities and developing innovative business models.
CLOBJ 3	To understand the critical role of the market in bioentrepreneurship, including market research, customer segmentation, and competitive analysis.
CLOBJ 4	To understand the role of government in fostering bioentrepreneurship, including the availability of government schemes, funding opportunities, and regulatory frameworks.
CLOBJ 5	To contrast the different applications of bioentrepreneurship across various sectors, such as pharmaceuticals, agriculture, environmental biotechnology, and industrial biotechnology.

f) Course Learning Outcomes:

CLO 1	Understand the basic concept of entrepreneurship and entrepreneur.
CLO 2	Inspect the business development in biotechnology.
CLO 3	Compare basic role of Market for Bioentrepreneur:
CLO 4	Understand the role of government and their schemes for bio-entrepreneurship.
CLO 5	Contrast the different applications of bio-entrepreneurship.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching hours**

1	**Entrepreneurship and Entrepreneur** Introduction of Entrepreneur and Entrepreneurship, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneurs, Development of Entrepreneurship steps in entrepreneurial process, Biotech Entrepreneurship in India.	**20**	**10**
2	**Business Development in Biotechnology** Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources, project location, end product, quality issues, etc). Basic principles and practices of management - Definition, concepts and application; Organization types, coordination, control and decision making in management.	**20**	**10**
3	**Market for Bioentrepreneur** Identification of market potential of various bioentrepreneur sectors. Marketing research, establishment of biotechnological start-up - Different models of biotechnological start-ups. The budget for a biotechnological start-up company.	**20**	**10**
4	**Role of Government and their Schemes** Seed capital raising for a biotechnological startup company and government support, Financial institutions in fostering Bio- entrepreneurship, Skills in bio-entrepreneurship- presentations, business proposal writing for different government schemes.	**20**	**7**
5	**Applications of Bio-entrepreneurship** Emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research Organization, marketing consultancy. Ethics and IPR in biotech-Industries - Fundamentals of ethics in business, IPR- Introduction, Forms of IPR.	**20**	**8**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Biotechnology Entrepreneurship: Managing, and Leading Biotech Companies (TextBook)**
By Craig Shimasaki | Academic Press | 1, Pub. Year 2014
2. **Biotechnology Entrepreneurship from Science to Solutions -- Start-Up, Company Formation and Organization, Team, Intellectual Property, Financing,**
By Michael L. Salgaller. | Logos Press | 1, Pub. Year 2010
3. **How to Start a Biotech Company**
By Sourish Saha et.al., Pub. Year 2019
4. **Introduction to Biotech Entrepreneurship: From Idea to Business. A European Perspective. (TextBook)**
By Matei, Florentina, Zirra, Daniela (Eds.). | Springer nature, Pub. Year 2019

a) Course Name: Biomaterials and Implants

b) Course Code: 03630385

c) Prerequisite: Basic knowledge of biology and human anatomy.

d) Rationale: This course explains basics of biomaterials and implants.

e) Course Learning Objective:

CLOBJ 1	To gain comprehensive knowledge about biomaterials, including their classifications, properties (mechanical, physical, chemical, and biological), performance specifications, and a wide range of biological applications.
CLOBJ 2	To develop the ability to critically evaluate and select the most suitable biomaterial or implant for a specific application.
CLOBJ 3	To understand and be able to decide on appropriate testing and selection procedures for specific biomaterials and implants, including in vitro and in vivo testing methods.
CLOBJ 4	To understand and be able to contrast different methods for assessing biocompatibility.
CLOBJ 5	To develop the skills to design and develop artificial models and materials.

f) Course Learning Outcomes:

CLO 1	Learn about biomaterials, classifications, their properties, performance specification and biological applications.
CLO 2	Judge which material/implant should be used for what kind of application according to nature of diseased and ill area of the body.
CLO 3	Decide the testing and selection procedure for specific biomaterial/implant.
CLO 4	Contrast on the testing of biocompatibility.
CLO 5	Develop and design artificial models/materials with the help of software available in market.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h) Course Content:

Sr.	**Content**	**Weightage (%)**	**Teaching hours**

1	**Biomaterial** Introduction, types, properties Synthetic, Metals and non-metallic alloys, Ceramics, Inorganics and glasses. Bioresorbable and biologically derived materials.	**25**	**7**
2	**Metals and Ceramics** Formation of stainless steel & its application, Titanium & its alloys. Types of carbon and their formation along with applications. Describe the types of Al and their formation along with applications.	**15**	**8**
3	**Polymers** Polymerization process & it's classification, usage of polymer in biomedical field, Polyamides & Polymethylacrylate Polymers, polyethylene & polypropylene applications.	**15**	**8**
4	**Biocompatibility** Methods for testing and evaluating biocompatibility: In Vitro Testing, In Vivo Testing; Hemocompatibility, Osteocompatibility, Odontocompatibility, Cytotoxicity Testing, Hypersensitivity/ Allergic Responses, Genotoxicity, Tissue reaction to external materials, Blood/biomaterial interaction, Corrosion and wear of biomaterials.	**25**	**9**
5	**Cardiac Implants** Cardiac Implants: Vascular grafts, Artificial Heart Valves, Synthetic Blood vessels, Inferior Vena Cava Filters Opthalmic Implants: Contact lenses; Soft and hard lenses, Disposable lenses, Intra Ocular Lenses (IOLs), Viscoelastic solution, Vitreous Implants, Eye shields, Orthopedic Implants: Temporary fixation devices, Fracture healing, Repair of the ligaments, Bone regeneration with re-sortable material Dental Implants: Dental implant modalities: Dentures, Subperiosteal, Endosteal; Blade type, Root form, Packaging and preparation of dental implants, Bases liners and varnishes for cavities, Impression materials.	**20**	**13**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Biomaterials Second Edition, Narosa Publishing House, 2005. (TextBook)**
By Sujata V. Bhatt
2. **Biomaterials science and engineering**
By J. B. Park | Plenum press, New York
3. **Biomaterials Science- An introduction to materials in medicine**
By Buddy D. Ratner, Allan S. Hoffman, Frederick j. Schoen, Jack E. Lemons
4. **Biomaterials Medial Devices and Tissue Engineering (TextBook)**
By Fredrick H. Silver Chapman and Hall
5. **Biomaterials- An introduction**
By Joon B. Park and Roderic S. Lakes

a) Course Name: Genomics and Proteomics

b) Course Code: 03630387

c) Prerequisite: Basic Knowledge of Molecular Biology and Biochemistry.

d) Rationale: This course introduces the concept and applications of genome and proteome analysis.

e) Course Learning Objective:

CLOBJ 1	To acquire in-depth knowledge of protein-protein interactions, protein-nucleic acid interactions, and other macromolecular interactions.
CLOBJ 2	To apply the knowledge of genome sequencing projects, including Next-Generation Sequencing (NGS) technologies, in the context of translational research.
CLOBJ 3	To gain a comprehensive understanding of the fundamental concepts and applications of Bioinformatics for analyzing genomic data
CLOBJ 4	To understand the basic principles of Pharmacogenetics, including how genetic variations can influence individual drug responses
CLOBJ 5	To acquire knowledge of functional genomics, including gene expression profiling and systems biology approaches, and structural proteomics.

f) Course Learning Outcomes:

CLO 1	Acquire the knowledge for interactions of proteins and other macromolecules along with methods for their identification.
CLO 2	Apply the concept of genome sequencing projects, NGS techniques in translational research.
CLO 3	Understand the basic concept and application of Bioinformatics and databases for different genomic projects.
CLO 4	Understand the basic principles of Pharmacogenetics.
CLO 5	Knowledge about functional genomics and structural proteomics.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Content	Weightage (%)	Teaching hours
1	**Introduction to Genomics** Genomics: Structural organization of genome in Prokaryotes and Eukaryotes; Organelle DNA: Mitochondria and chloroplast; DNA sequencing its uses in translational research; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR.	**20**	**10**
2	**Genome Sequencing Projects** Genome Sequencing Projects of Microbes, plants and animals; Accessing and retrieving of genome project through web; Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.	**20**	**8**
3	**Proteomics Analysis** Analysis of Proteins (includes measurement of concentration, amino acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Iso-electric focusing; Peptide mass fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDITOF; SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid system.	**15**	**10**
4	**Pharmacogenetics** High throughput screening in genome for drug target identification, drug discovery, identification of gene targets, Applications of pharmacogenetics and drug development, Therapeutic proteins.	**20**	**7**
5	**Functional Genomics and Proteomics** Analysis of microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays; Structural proteomics.	**25**	**10**
Total		**100**	**45**

i) Text Book and Reference Book:

1. **Discovering Genomics, Proteomics and Bioinformatics (TextBook)**
By Campbell AM & Heyer LJ | Benjamin Cummings | 2
2. **Developing Bioinformatics computer skills**
By O' Reilly | SPD publication | 1st Indian, Pub. Year 2001
3. **Principles of Gene Manipulation and Genomics**
By Sandy B. Primrose and Richard Twyman
4. **Genomes**
By Brown TA | Garland Science. | 3
5. **Molecular Biotechnology**
By Glick BR & Pasternak JJ | ASM Press | 3