

DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**CIRCULAR NO.SU/Sci.& Tech./B.Voc./33/2018**

It is hereby inform to all concerned that, on the recommendation of the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following curriculum under B.Voc. programme viz: Certificate, Diploma, Advanced Diploma and B.Voc. Degree** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith:

1.	B.Voc. Industrial Automation,
2.	B.Voc. Automobile Technology,
3.	B.Voc. Farm Equipment and Machinery,
4.	B.Voc. I.T.Skills and Software Development,
5.	B.Voc. Architectural Planning and Interior Design,
6.	B.Voc. Dairy Products,
7.	B.Voc. Drill Technology,
8.	B.Voc. Plant Tissue Culture and Green House Technology,
9.	B.Voc. Renewable Energy Source,
10.	B.Voc. Computer Hardware & Networking Maintenance.
11.	B.Voc.Food Processing and Preservation.
12.	B.Voc. Sustainable Agriculture.
13.	B.Voc. Bioprocesses technician

This is effective from the Academic Year 2018-2019 and onwards.

This curriculum are also available on the university website
www.bamu.ac.in

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
Ref.No.
SU/B.Voc/2018/21709-22148
Date:- 12-12-2018

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12/12/18
Deputy Registrar,
Syllabus Section.

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Copy forwarded with compliments to :-

- 1] **The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.**
- 2] **The Director, University Network & Information Centre, UNIC,
with a request to upload this Circular on University Website.**

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- 1] The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.
- 2] The Section Officer, [BCS Unit] Examination Branch,
- 3] The Section officer, [Eligibility Unit], Dr.BAMU,A'bad.
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Pariksha Bhavan, Dr. Babasaheb Ambekar Marathwada University.
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**D.R. BABASAHEB AMBEDKAR
MARATHWADA UNIVERSITY,
AURANGABAD.**



**Curriculum of
B.Voc. Bioproducs Technician**

UNDER THE FACULTY OF SCIENCE & TECHNOLOGY.

[Effective from 2018-19 & onwards]

Course Structure for Certificate/Diploma under B.Voc. Bioprocess technician

S.N	Paper No	Paper Title	No. of Credits	Scheme of Teaching	Scheme of Evaluation				
				Theory / Practical per week (in Hrs)	Theory / Practical Marks		Univ. Exam duration (in hrs)	Total Marks	
Semester – I					Th C U A A		Pr		
General Education Component (12 credits)									
1	BPT101	Basic biology-I	4	4	50	50	3	100	
2	BPT 102	Basic Computing & electronics	2	2	25	25	2	50	
3	BPT 103	Practicals based on Basic Biology-I	2	4			50	50	
4	BPT 104	Basic Chemistry-I	4	4	50	50	3	100	
Skill Education Component (18 Credits)									
5	BPT 151	Analytical techniques	2	2	25	25	2	50	
6	BPT 152	Basic Microbiology	2	2	25	25	2	50	
7	BPT 153	Basic Biochemistry	2	2	25	25	2	50	
8	BPT 154	Practicals based on Analytical techniques	4	8			100	3	
9	BPT 155	Practicals based on Basic Microbiology	4	8			100	3	
10	BPT 156	Practicals based on Basic Biochemistry	4	8			100	3	
		Total	30	44				750	
Semester –II									
General Education Component (12 credits)									
1	BPT201	Basic biology-II	4	4	50	50	3	100	
2	BPT 202	Basic Computing & electronics-II	2	2	25	25	2	50	
3	BPT 203	Practicals based on Basic Chemistry	2	4			50	50	
4	BPT 204	Basic Chemistry-II	4	4	50	50	3	100	
Skill Education Component (18 Credits)									
5	BPT251	Applied thermodynamics	2	2	25	25	2	50	
6	BPT252	Applied microbiology	2	2	25	25	2	50	
7	BPT253	Fermenter Design-I	2	2	25	25	2	50	
8	BPT254	Practicals based on Industrial media and energy balance	4	4			100	3	
9	BPT255	Practicals based on applied microbiology	4	4			100	3	
10	BPT256	Practicals based on operation of fermentation process	4	4			100	3	
		Total	30	44				750	

Note: Theory and practical exam should be conducted at the end of each semester

Course Structure for Advanced Diploma under B.Voc. Bioprocesses technician

S.N	Paper No	Paper Title	No. of Credits	Scheme of Teaching	Scheme of Evaluation				
				Theory / Practical per week (in hrs)	Theory / Practical Marks	Univ. Exam duration (in hrs)	Total Marks		
Semester – III					Th CA UA	Pr			
1	BPT301	Biostatistics	4	4	50	50		3	100
2	BPT302	Central Dogma	4	4	50	50		3	100
3	BPT303	Plant Breeding	4	4	50	50		3	100
4	BPT351	Fermenter Design-II	2	2	25	25		2	50
5	BPT352	Upstream process-I	2	2	25	25		2	50
6	BPT353	Upstream process-II	2	2	25	25		2	50
7	BPT354	Practicals based on Fermenter Design-II	4	8			100	3	100
8	BPT355	Practicals based on Food products	4	8			100	3	100
9	BPT356	Practicals based on upstream processing and application of fermentation	4	8			100	3	100
		Total	30	42					750
Semester –IV									
1	BPT401	Recombinant DNA Technology	4	4	50	50		3	100
2	BPT402	Enzyme Technology	4	4	50	50		3	100
3	BPT403	Plant Tissue Culture	4	4	50	50		3	100
4	BPT451	Fermentation process and control-I	2	2	25	25		2	50
5	BPT452	Downstream process-I	2	2	25	25		2	50
6	BPT453	Downstream process-II	2	2	25	25		2	50
10	BPT454	Practicals based on Biomass	4	8			100	3	100
11	BPT455	Practicals based on Enzyme Technology and RDT	4	8			100	3	100
12	BPT456	PTC and Plant Breeding	4	8			100	3	100
		Total	30	42					750

Note: Theory and practical exam should be conducted at the end of each semester.

Course Structure for Degree in B.Voc. Bioprocess technician

S.N	Paper No	Paper Title	No. of Credits	Scheme of Teaching	Scheme of Evaluation				
				Theory/ Practical per week (In hrs.)	Theory/ Practical marks		Univ. Exam duration (In hrs)	Total Marks	
Semester – V					Th	Pr			
					CA	UA			
1	BPT301	Bioprocess monitor & Control-II	4	4	50	50		3	100
2	BPT302	Animal cell culture technology & transgenic animals	4	4	50	50		3	100
3	BPT303	Neutraceuticals	4	4	50	50		3	100
4	BPT351	Growth energetics	2	2	25	25		2	50
5	BPT352	Biosimulators	2	2	25	25		2	50
6	BPT353	Post-production cleaning & maintenance	2	2	25	25		2	50
7	BPT354	Practicals based on Neutraceuticals	4	8			100	3	100
8	BPT355	Practicals based on Cosmetics	4	8			100	3	100
9	BPT356	Practicals based on Biopolymers	4	8			100	3	100
		Total	30	42					750
Semester –VI									
1	BPT401	Supply chain & enterprise resource planning in Biomanufacturing	4	4	50	50		3	100
2	BPT402	Methods in quality improvement, investigations & Audits	4	4	50	50		3	100
3	BPT403	Bioethics & IPR	4	4	50	50		3	100
4	BPT451	Documentation & Record keeping	2	2	25	25		2	50
5	BPT452	Bioremediation Technology	2	2	25	25		2	50
6	BPT453	Bioenergy production	2	2	25	25		2	50
10	BPT454	Practicals based on Biopharmaceuticals	4	8			100	3	100
11	BPT455	Practicals based on Feed Stock Production	4	8			100	3	100
12	BPT456	Practicals based on Biofuels	4	8			100	3	100
		Total	30	42					750

Note: Theory and practical exam should be conducted at the end of each semester

General Education Components

BPT101: Basic Biology

Learning Objectives:

1. The student will be able to read, understand, and critically interpret the primary biological literature in his/her area of interest.
2. The student will be able to design, conduct, analyze, and communicate (in writing and orally) biological research.

Learning Outcomes:

1. Students will be able to explain the basic concepts of biology.
2. Students will learn a variety of skills necessary to function as a biologist in the workplace.
3. Students will demonstrate the ability to articulate, verbally and in writing, knowledge of biology, biological methods, and biological issues in context.

UNIT I

Classification of Organisms Classification of organisms (Binomial system), Species, Species name, taxonomic hierarchy. Three Domains of life- Archaeobacteria, Eubacteria, Eukarya, Five Kingdom classification, Viruses – a special case as exception.

UNIT II

Bacteria; Prevalence of bacteria, bacterial forms, basic structure (surface and interior), Bacterial Diversity, Classification of bacteria, Importance of bacteria.

UNIT III

Plant Kingdom, Histology, Tissue types - Meristematic, permanent, Types of Vascular Bundles, Stellar types and evolution, Plant physiology.

UNIT IV

Animal cell structure & function, Nutrition and digestion, Gas exchange, Circulation, Immune System, homeostasis, hormones and endocrine systems, reproduction & embryonic development, Nervous system, Motion, Sense organs.

UNIT V

Origin and Evolution of life Origin of life, Evolution of life forms, Evidences of evolution, Mechanism of evolution, Hardy - Weinberg Principle, A brief account on evolution.

Reference books:

1. Brock Biology of Microorganisms - Madigan et al, 9th ed.
2. Biology by Raven and Johnson
3. Biology by Campbell and Reece
4. Exploring creation with Biology – Wile and Durnell.

BPT102: Basic Computing & electronics

Learning Objectives:

1. To understand the main components of an OS & their functions.
2. Gain core knowledge of Network layer routing protocols and IP addressing.
3. Study various data transfer techniques in digital computer.
4. To understand number representation and conversion between different representation in digital electronic circuits.

Learning Outcomes:

1. Describe the functions of each layer in OSI and TCP/IP model.
2. Describe and analyse the memory management and its allocation policies.
3. Identify and compare different methods for computer I/O mechanisms.
4. Develop a digital logic and apply it to solve real life problems.

Unit I

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing,

Unit II

Network Topologies and Protocols, Networking gadgets (Router, Switch, etc), Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc). Local Area Network (LAN), Wide Area Network (WAN),

Unit III

Algorithm: Definition, Characteristics, Advantages and disadvantages, Examples

Flowchart: Definition, Define symbols of flowchart, Advantages and disadvantages, Examples

Unit IV

Structure of Instruction, Description of Processor, Processor Features RISC & CISC Number Systems.

Unit V

Logic Gates and Flip Flops: AND, OR, NOT, Ex-OR, Ex-NOR, Flip Flops and Its Types. Power Supply and Types (AC & DC) Electronic Components: Diode, Resistor, Capacitor, Amplifier, Integrated Chips, Inductor, Transistor, Switch, Coils.

Reference books:

1. Trainer T., et al, "Computers", McGraw Hill.
2. Norton, Peter, "Introduction to Computers, Mc-Graw-Hill
3. Digital Electronics and Micro-Computers – R.K.Gaur , Dhanpat Rai Publication.

BPT103: Practicals based on Basic Biology-I

Learning Objectives:

1. Develop their knowledge and understanding of the natural world.
2. Learn how use a piece of scientific equipment or follow a standard practical procedure.
3. Develop their understanding of the scientific approach to enquiry.

Learning Outcomes:

1. Acquire knowledge and develop understanding of biological principles, concepts, terms and facts.
2. Develop biological practical techniques and process skills.

Practicals:

1. Study parts of a dissecting microscope and compound microscope.
2. Detection of normal and abnormal constituents of urine – sugar, albumen bile and blood cells.
3. To study the effect of different temperatures and three different pH on enzyme (amylase) action on starch solution.
4. To study the rate of respiration in germinating seeds and/or flower buds.
5. To study Morphology and modification of roots, stems and leaves.
6. Preparation of temporary slides of Mucor / Rhizopus.

BPT104: Basic Chemistry-I

Learning Objectives:

1. The aim of this course is to develop better understanding of basic principles of chemistry including organic, inorganic and physical chemistry.
2. To study classification and nomenclature of organic compounds in trivial and IUPAC system.
3. To develop understanding of different types of spectroscopy and their applications, methods of purification of organic compounds.
4. To study the range and chemistry of elements in periodic table and their compounds.

Learning outcomes:

1. The student will learn the laboratory skills needed to design safely conduct and interpret the chemical research.
2. The student will have ability to understand the mechanisms used to predict the products of organic chemical reactions.
3. The student will learn and apply basic techniques used in organic laboratory for preparation, purification and identification of organic compounds.
4. The student will develop the ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

Unit-I

Importance of chemistry, types of organic compounds, Reaction mechanisms.

Unit-II

Importance of Chemistry, basic physical quantities and their measurements, SI Units, Dimensional Analysis, matter and its nature, atomic and molecular masses, molar masses, laws of chemical combinations, molecular formula.

Unit-III

IUPAC nomenclature system purification methods, composition of organic compounds.

Unit-IV

Long form of periodic table: - Mosley's modern periodic law extended periodic table, classification elements, predication of period group and block of a given element.

Unit-V

Spectroscopy: - Concept and principal of spectroscopy, Electromagnetic radiations types of spectroscopy and their applications.

Reference Books:

1. Organic Chemistry by Bahl and Bahl.
2. Reaction and recovery of chemicals by S. N. Sanyal.
3. Inorganic chemistry by J.D.Lee.
4. J. March: Advanced Organic Chemistry

Skill Education Component

BPT151: Analytical techniques

Learning Objectives:

The objective of the course is to create general understanding of pH measurement, microscopy, calorimetry, electrophoresis, Chromatography, centrifugation, flow cytometry.

Learning outcomes:

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in instrumentation used in bio products.

Unit-I

Basic Laboratory Instruments: Principle and working of pH meter, autoclave, HAO laminar air flow.

Unit-II

Microscopy: Microscope Types: Light and electron, Resolving power, Numerical aperture, limit of resolution, magnification, principle, working, ray- diagram and applications of bright field, dark field, fluorescent and phase contrast microscopy, Transmission and scanning electron microscopy.

Unit-III

Centrifugation- types, preparative, analytical and differential, sedimentation velocity and sedimentation equilibrium.

Electrophoresis: Basic principle of electrophoresis theory and applications of paper and gel electrophoresis.

Unit-IV

Chromatographic Techniques: Theory, Principle and applications of Thin layer chromatography, paper chromatography, Ion exchange, chromatography, affinity chromatography and HPLC.

Unit-V

Flow cytometry: Principle, working, instrumentation and applications of a flow cytometer.

Reference Books:

1. Biophysical Chemistry by Nath and Upadhyay.
2. Practical biochemistry principles and techniques by Wilson and Walker.
3. Instrumental methods of chemical analysis by Chatwal and Anand.
4. Lab Manual in Biochemistry by J. Jayaraman.
5. Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.
6. Analytical Biochemistry by Holme

BPT152: Basic Microbiology

Learning Objectives:

- The study of microbes helps us to understand our world and our place within it.
- It gives us insights into the complexity of nature and society, which in turn provide much different health, environmental, social, cultural, industrial and economic benefits.
- Microbiology is the study of organisms that are too small to be observed with the naked eye. Microorganisms include algae, bacteria and fungi.

Learning outcomes:

1. Students will be able to acquire and apply specialized language and knowledge relevant to microbiology.
2. Students will acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

Unit I

Introduction, History of Microbiology, Overview of Microbial Taxonomy. General Characteristics and applications of different microbial groups- Fungi, Algae, Actinomycetes

Unit II

Ultrastructure of Bacterial Cell, Structure of Endospore, Stages of Sporulation and Germination of endospore. Bacterial Toxins

Unit III

Microbial Growth, Concept of Microbial Growth, Continuous and Batch Culture. Monoauxic, Diauxic and Synchronous Growth. Bacterial Growth Curve. Generation Time. Methods of Synchronisation.

Unit IV

Viruses and Fungi- Overview of structure and classification.

Unit V

General characteristics of viruses. Plant viruses. Fungi of industrial importance.

Reference Books:

1. Prescott, L.M J.P. Harley and C.A. Klein 1995. Microbiology 2nd edition Wm, C. Brown publishers.
2. Michael J. Pelczar, Jr. E.C.S. Chan, Moel : Microbiology Mc Graw Hill Book R. Krieg, 1986 Company
3. Stainer R.Y. Ingraham J.L. Wheolis H.H and Painter P.R. 1986 The Microbial world, 5th edition. Eagle Works Cliffs N.J. Prentica Hall.

BPT153: Basic Biochemistry

Learning objectives:

- The course aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis. To study and understand the structures and properties of substances consisting the framework of cell and tissues.
- The course aims to provide students with an advanced integrated knowledge and understanding of core topics, with general principles set in particular contexts
- To study the manifold energy-requiring process of the living cell.

Learning Outcomes:

1. Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.
2. Biochemistry majors will gain proficiency in basic laboratory techniques in both chemistry and biology, and be able to apply the scientific method to the processes of experimentation and hypothesis testing.
3. Students in the Biochemistry Major will be able to apply and effectively communicate scientific reasoning and data analysis in both written and oral forums.

Unit I: Basic concepts

Introduction to biochemistry, its scope, significance and applications. pH, pKa, Buffers, H.H. equation.

Unit II: Carbohydrates

Definition, classification, structure, function and properties of monosaccharide, Disaccharide and polysaccharide.

Unit III: Amino acids and proteins

Amino acids: - classification, structure, general reactions of amino acids.

Proteins: - classification, bonds involved in protein (peptide bond, disulphide bond, ionic bond, hydrogen bond, hydrophobic bond), structure of proteins.

Unit IV: Lipids

Classification, structure of saturated and unsaturated fatty acids, properties and biological function of lipids.

Unit V: Nucleic acids

Classification, structure, physio-chemical properties and types of nucleic acids.

Reference Books:

1. Outline of Biochemistry-By Cohn and Stump
2. Biochemistry-By Lubert Stryer
3. Principles of Biochemistry-By Lehninger
4. Biochemistry-By Zubay
5. Harper's review of Biochemistry

BPT154: Practicals based on analytical techniques

1. Study of titration curve of acetic acid & determination of pKa.
2. Study of UV-absorption spectra of macromolecules (Nucleic acid & protein).
3. Determination of λ max of given dye solution.
4. Spectrophotometric determination of nucleic acid purity & concentration.
5. Separation & identification of amino acids using TLC & paper chromatography.
6. Separation & Identification of sugars using paper chromatography.
7. Separation & Identification of lipids by TLC.
8. Separation of serum proteins by gel electrophoresis.

BPT155: Practicals based on Basic Microbiology

1. Study of bacterial morphology by simple staining /Monochrome staining
2. Differential staining technique- Gram staining
3. Wet Mounting of Fungi to study morphology
4. Complex media preparation- Nutrient Agar
5. Selective media for *S. typhi*, *S. aureus*, Actinomycetes
6. Differential Media preparation Mac Conkey agar

Reference Books:

1. Microbiology – Pelczar
2. Principles of Bacteriology- A. J. Salle
3. Microbiology- Prescott
4. General Microbiology- R. Y. Stanier
5. Text book of Microbiology by Tortora

BPT156: Practicals based on Basic Biochemistry

1. Qualitative test for Carbohydrates.
2. Estimation of Carbohydrates by using Anthrone method.
3. Estimation of reducing sugar by Sumner's method.
4. Qualitative test for protein and amino acids.
5. Estimation of protein by Folin-Lowry method.
6. Estimation of protein by Biuret method.
7. Estimation of Vitamin C.
8. Preparation of buffers.
9. Estimation of DNA.
10. Estimation of RNA.
11. Estimation of amino acids.

Semester II

BPT201: Basic Biology-II

Learning Objectives:

- Students will understand how these cellular components are used to generate and utilize energy in cells.
- Students will understand the cellular components underlying mitotic cell division.
- Students will understand the major components of Animal & Plant physiology.

Learning outcomes:

1. Be able to evaluate scientific information regarding animal and plant physiology and molecular biology, and summarize scientific papers in the fields of animal and plant physiology.
2. Use their knowledge about organs, organ structure and different cell types to explain and describe the specialized functions and regulations of the major organs and organ systems in the animal kingdom.

Unit I

Cell cycle, Phases of cell cycle, Binary fission and Budding, Mitosis, Significance of mitosis, Meiosis, Significance of meiosis.

Unit II

Absorption of water and nutrients, Translocation of solutes, Transpiration, Photosynthesis, Photorespiration, Respiration.

Unit III

Plant growth, Differentiation, Dedifferentiation, Development of plant, Plant hormones, Photoperiodism, Vernalisation.

Unit IV

Absorption, Digestion, Circulatory system, Respiratory system, excretory system, and Nervous system, Hormonal co-ordination.

Unit V

Bacterial recombination (Conjugation, Transformation, Transduction), Sporulation, Adaptations with respect to extreme environments.

Reference Books:

1. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 5th Ed, W. H. Freeman & Co, 2002.
2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, Macmillan Worth, 2000.

BPT202: Basic Computing & electronics-II

Learning Objectives:

- Computer networks and concentrates on building a firm foundation for understanding Data Communications and Computer Networks.
- OSI Reference Model that deals with the major issues in the bottom three (Physical, Data Link and Network) layers of the model.

Learning outcomes:

1. Have a basic knowledge of the use of Operating System and network security.
2. Understanding of the OSI Reference Model and in particular have a good knowledge of Layers.
3. Manage multiple operating systems, systems software, network services and security.

Unit I:

Operating system Concepts: Why Operating System? Functions of Operating System, Booting of Operating System and its type. Types of Operating System: Batch Operating System, Multiprogramming Operating System, Time Sharing Operating System, Personal Computers Operating System, Network Operating System.

Unit II:

Combinational and Arithmetic Logic Circuits: Half Adder & Full Adder, Binary parallel Adder, Half Subtractor, Full Subtractor, Adder / Subtractor in 2's complement system. BCD to Decimal decoder: 2:4 De-multiplexer, 4 line to 1 line multiplexer.

Unit III:

Units, Measurements and Conversion: Need for measurement related to electronics (resistance, capacitance, inductance, voltage, current, frequency, time, power, energy and wavelength) and their units (Milli, micro, kilo, nano, pico, mega, giga etc.) and conversion. Concept of pixel, resolution.

Unit IV:

Multimeter: Construction & various functions of multimeter & the various measurements that are made using multimeter, Specification of multimeter & their significance and its limitations. Electronic voltmeter:-Advantages over conventional multimeter for voltage measurement with respect to input impedance and sensitivity.

Unit V:

Network Software & Network Standardization: Introduction: Networks Software; Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, Service Primitives: Reference models; The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Models: Network standardization.

Reference Books:

1. Fundamentals of Computers: By V.Rajaraman, PHI Publication.
2. Digital Electronics and Micro-Computers By R.K.Gaur , Dhanpat Rai Publication
3. Elements and Electronic Instruments and Measurement, By Carr Pearson.
4. Computer System Architecture, By Morris Mano, PHI
5. Computer Networks. By A. Tanenbaum, Pearson Education.

BPT203: Practicals Based on Basic Chemistry

1. Systematic qualitative analysis of organic compounds through nature, element, functional group detection and physical constant of elements
a) Benzoic acid b) β -naphthol c) acetanilide d) p-nitroaniline
2. Acid-base titration
3. Purification of organic compound by crystallization - Benzoic acid
4. Purification of organic compound by sublimation - Naphthalene
5. Determination of water of crystallization of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

BPT204: Basic Chemistry- II

Learning Objectives:

- The aim of this course to develop understanding of fundamental properties of atoms molecules and the various states of matter.
- To understand preparation of solutions simple chemical kinetics including zero, first and second order rate laws.
- To study and understand calculation of oxidation numbers, identification of redox reactions, oxidation reduction reactions, oxidizing and reducing agent.

Learning outcomes:

1. The student will have ability to perform a various basic procedures in the chemistry lab including weighing samples, titration, and solution preparation.
2. The student will have ability to keep accurate and detailed records of what was done during experiments.
3. The student will develop the ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

Unit- I

Concept of atom, molecule, mole concept, empirical and molecular formulae, atomic and molecular masses, nature of matter subatomic particles, quantum numbers, electronic configuration of elements, types of bonds.

Unit-II

Concept of solution, methods of expressing concentration, colligative properties of solutions, rate of chemical reaction and units, factors affecting rate of reaction.

Unit-III

Order and molecularity of reaction.

Unit-IV

Oxidation number, oxidation state, rules for calculating oxidation number, concept of oxidation, reduction

Unit-V

Redox reaction, oxidising and reducing agents, gravimetric and volumetric analysis (titration).

Reference Books:

1. Physical Chemistry by Bahl and Bahl.
2. Physical Chemistry by G. M. Barrow.
3. Physical Chemistry by Lewis.
4. Inorganic chemistry by J. D. Lee.

BPT251: Applied Thermodynamics

Learning Objectives:

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behaviour and performance.

Learning outcomes:

1. Upon completion of this course, the students can able to apply the Thermodynamic Principles to Bioprocesses technician.
2. Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures

Unit I

Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

Unit II

Second law of thermodynamics, Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. entropy change for – pure substance, ideal gases – different processes, principle of increase in entropy. Applications of II Law.

Unit III

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart.

Unit IV

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties-.Compressibility factor-.Principle of Corresponding states. - Generalised Compressibility Chart and its use-.

Unit V

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function.

Reference Books:

1. Cengel. Y and M.Boles, "Thermodynamics – An Engineering Approach", 7th Edition, Tata McGraw Hill, 2010.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 1995.
3. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice-Hall of India Pvt. Ltd, 2006
4. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

BPT 252: Applied Microbiology

Learning Objectives:

- Knowledge on the understanding of the concepts and fundamental principles of microbiology; key features of the structure, growth, physiology and behaviour of bacteria, viruses, fungi and protozoa.
- Basic knowledge to deal with the study of genetic, metabolic strategies and ecology of microorganisms.
- Basic knowledge of the main microbiological techniques to be applied in the laboratory.

Learning Outcomes:

1. The students will be able to select and use appropriate laboratory media for microorganism of interest in a safe and responsible manner.
2. The students will be able to grow, identify & count microorganisms.
3. Understand the role microorganisms in various fields.

Unit I

Bacterial Nutrition- Major and minor nutrients. Construction of culture media for bacteria, fungi and actinomycetes. Classification of microorganisms.

Unit II

Isolation of Bacteria by pour plate, spread plate and streak plate technique. Pure culture techniques. Preservation of culture. Biochemical Tests, sugar fermentation tests etc.

Unit III

Effect of temperature, pH, Oxygen on microbial growth. Control of microbial growth. Various physical and chemical agents used to control microbial growth.

Unit IV

Antimicrobial compounds, Antifungal antibiotics, antiviral compounds.

Unit V

Antibiotics affecting cell wall, cell membrane protein synthesis.

Reference Books:

1. General Microbiology Stanier, Ingraham and Painter.
2. Environmental Microbiology Maier, Pepper and Garba.
3. Text Book of Microbiology Ananth Narayan & Panikar

BPT 253: Fermenter design-I

Learning Objectives:

- To understand process and measurement techniques in fermenter.
- To understand the basic design of fermenter and its operations.

Learning Outcomes:

1. The students will be able to understand design and working of fermenter.

Unit I

Design of bioreactors (Fermenter): Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings.

Unit II

Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases.

Unit III

Automation (processes computerization). Validation of Fermenter. Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed.

Unit IV

Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors.

Unit V

Heat and Mass transfer in Bioprocess, Relationship in between heat transfer, cell concentrations and stirring conditions, Measurement of K_La , Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters.

Reference Books:

1. Principles of fermentation technology P.F. Stanbury & Whitaker Pergamon Press, II Ed, Butterworth Heinemann-Elsevier, 2005.
2. Bioprocess Engineering, Basic Concepts, II Ed. Michael L Shuler, Fikret Kargi, Prentice Hall of India pvt. Ltd. 2002.
3. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press an Imprint of Elsevier.
4. Coulson & Richardson's Chemical Engineering, R.K. Sinnott, III Ed. Vol 6 Butter worth Heinemann-Elsevier Pub, 1999.

BPT 254: Practical's based on Industrial media and energy balance

1. Screening and Isolation of industrially important Microorganisms (such as Enzymes, and Organic acid Producing)
2. Screening and Isolation of Antibiotic producers.
3. Inoculum preparation for industrial production of Glutamic acid.
4. Inoculum preparation for industrial production of Alcohol.
5. Preparation of various Fermentation media for industrial production of Glutamic acid and Penicillin.
6. Media optimization for industrial production of Lactic acid.
7. Media optimization for industrial production of Alcohol.

BPT 255: Practical's based on applied microbiology

1. Isolation of bacteria from soil by serial dilution and streak plate technique
2. Isolation of bacteria from water by spread plate technique.
3. Study of effect of temperature on bacterial growth.
4. Study of effect of pH on bacterial growth.
5. Sugar Fermentation tests for identification of bacteria
6. IMViC test.
7. Bacterial Growth curve

BPT 256: Practical's based on operation of fermentation process

1. Basic design of a laboratory fermenter.
2. Cleaning and sterilization of fermenter vessel.
3. Determination growth curve in a batch culture.
4. Production of Ethanol by simple/complex carbohydrate sources (media) using *Saccharomyces cerevisiae*.
5. Production of wine from apple / grape juice by *Saccharomyces cerevisiae*.
6. Production of citric acid by solid-state-fermentation using *Aspergillus niger*.
7. Production of Fungal alpha amylase by solid state fermentation