Programme Template:

Programme Degree e.g. B.A./B.Com./B.Sc./ B.M.S., etc.		**B.Sc.**
Parenthesis if any (Specialization) e.g. History, Human Development, English, etc.		**Microbiology**
Preamble (Brief Introduction to the programme)		Microbiology is a branch of science that deals with study of microorganisms. The microbiological study has wide scope ranging from basic sciences to applied sciences. The prominent applied branches of microbiology that can be focused on Pharmaceutical microbiology, agricultural microbiology, food microbiology, environmental microbiology, medical microbiology, industrial microbiology and epidemiology. Various job opportunities are available for the students in the sector of industry, academia and government as well as non-government research institutes. Student can work as research fellow at various National Institutes, as Assistant Professor in colleges and Laboratory Technicians at Government and private pathological laboratories.
Programme Specific Outcomes (PSOs) *Action Verbs demonstrating (Major) discipline-related knowledge acquisition, mastery over cognitive and professional, vocational skills are to be used. e.g. demonstrate sound understanding of.., analyse, compare, create, design, etc…(minimum 5)*		**After completing this programme, Learners will be able to**
	1.	Apply knowledge and technical skills as they investigate broad variety of contemporary subjects covering different areas of microbiology.
	2.	Acquire critical thinking skills like hypothesis creation and testing, experiment design and execution, read and interpret scientific literature and demonstrate good written and oral communication via presentations.
	3.	Gain proficiency in skills needed for environmental sustainability
	4.	Enable students to go for higher studies in microbiology and allied subjects leading to post graduation and Ph.D. Degrees
	5.	Get employed at various National Institutes, academic institutes and Government and private pathological laboratories
	6.	Exemplify the diversity in the microbial world and evaluate their ecological role as well as state their significance to humankind.
	7.	Classify and characterize microorganisms based on their morphological, cultural, biochemical, and molecular properties
Eligibility Criteria for Programme		1. Female candidates with 12th Science in PCB Pass out (*Note: Admissions will be based on Merit)*
Intake (For SNDTWU Departments & Conducted Colleges)		The Program is offered at affiliated Colleges of SNDTWU.

- *External Examination does not always mean Theory paper. It may be practical examination, projects, presentations etc. Checked by external examiners.*
- *Internal evaluation should not only be written Theory papers like Unit tests. Internal marks will also be acquired through practical, small group or individual Projects, activities, presentations, seminars, assignments, etc.*
- *Practical may be part of the main courses along with theory modules instead of having separate courses of practical work*

Structure with Course Titles

(Options related to our area of study to be provided with "OR" for baskets of different types)

	SN	Courses	Type of Course	Credits	Marks	Int	Ext
		Semester I					
10132511 /	1.1	Fundamentals of Microbiology (Theory + Practical)	Major (Core)	4	100	50	50
10132512 /	1.2	Applied Microbiology- I (Theory + Practical)	Major (Core)	4	100	25	75
1043251	1.3	Basic Concepts In Immunology (Theory)	OEC	4	50	25	25
1063252	1.4	Basic Skills of Microbiological Laboratory (Practical)	VSC	2	50	25	25
1073252	1.5	Basic Concepts In Immunology (Practical)	SEC	2	50	25	25
1083251	1.6	Communication Skills and Critical Reading	AES	2	50	25	25
1103251	1.7	Introduction to Ancient Systems of Medicine	IKS	2	50	25	25
1113251	1.8	Environmental Science -1 (Theory)	VAC	2	50	25	25
11432501 / 11432502	1.9	Yoga with PD / any other subject from University Basket (University web portal)	CC	2	50	25	25
				22	**550**	**250**	**300**
		Semester II					
20132511 /	2.1	Fundamental of Microorganisms (Theory + Practical)	Major (Core)	4	100	25	75
2013251	2.2	Applied Microbiology- II (Theory)	Major (Core)	2	50	25	25
2033251	2.3	General Chemistry (Theory)	Minor Stream	2	50	25	25
2043251	2.4	Fermentation Technology (Theory)/	OEC	4	50	25	25
2063252	2.5	Food fermentation techniques (Practical)	VSC	2	50	25	25
2073251	2.6	Computer Applications	SEC	2	50	25	25
2083251	2.7	Communication Skills in English	AEC	2	50	25	25
2103251	2.8	Microbial diseases and traditional knowledge of medicine	IKS	2	50	25	25
21432501 / 21432502	2.9	Diet and Nutrition / any other subject from University Basket (University web portal)	CC	2	50	25	25
				22	**550**	**250**	**300**

Exit with UG Certificate with 10 extra credits (44 + 10 credits)

	SN	Courses	Type of Course	Credits	Marks	Int	Ext
		Semester III					
30132511 /	3.1	Cell Biology (Theory and Practical)	Major (Core)	4	100	25	75
3013251	3.2	Bacteriology (Theory)	Major (Core)	4	50	25	25
3033251	3.3	Physical Chemistry (Theory)	Minor Stream	4	50	25	25
3043251	3.4	Microbes in environment	OEC	2	50	25	25
3063252	3.5	Bacteriology (Practical)	VSC	2	50	25	25
3083251	3.6	Technical Seminar and Report Writing	AEC	2	50	25	25
3133250	3.7	Field Project In Microbiology labs in Hospitals, Companies, Clinics/ Pathology Labs	FP	2	50	25	25
31432501 / 31432502	3.8	NSS/NCC/CC	CC	2	50	25	25
				22	**550**	**250**	**300**
		Semester IV					
40132511 /	4.1	Clinical Microbiology (Theory+ Practical)	Major (Core)	4	100	25	75
4013251	4.2	Advanced Immunology (Theory)	Major (Core)	4	50	25	25
4033251	4.3	Biochemistry (Theory)	Minor Stream	4	100	50	50
4043251	4.4	Medical Microbiology	OEC	2	50	25	25
4063252	4.5	Biochemistry (Practical)	VSC	2	50	25	25
4083251	4.6	Biofertilizers and Biopesticides	AEC	2	50	25	25
41432501 / 41432502	4.7	NSS/NCC/CC	CC	2	50	-	50
4173250	4.8	Environmental Science	CEP	2	50	25	25
				22	**550**	**250**	**300**

Exit with UG Diploma with 10 extra credits (88 + 10 credits)

	SN	Courses	Type of Course	Credits	Marks	Int	Ext
		Semester V					
5013251	5.1	Microbial Genetics (Theory)	Major (Core)	4	100	25	75
50132512 /	5.2	Microbial Biotechnology (Theory and Practical)	Major (Core)	4	100	50	50
5013251	5.3	Virology (Theory)	Major (Core)	2	50	25	25
50232511 /	5.4	Genetic Engineering (Theory) / Bioinformatics (Theory)	Major (Elective)	4	50	25	25
5033251	5.5	Introduction to Analytical Chemistry (Theory)	Minor Stream	4	50	25	25
5063251	5.6	Laboratory Management	VSC	2	50	25	25
5173251	5.7	Community Engagement Projects such as medical camp, blood donation camps etc.	CEP	2	50	-	25
				22	**550**	**250**	**300**
		Semester VI					
6013251	6.1	Industrial Microbiology (Theory)	Major (Core)	4	100	25	75
6013251	6.2	Recombinant DNA Technology (Theory)	Major (Core)	4	50	25	25
6013252	6.3	Industrial Microbiology (Practical)	Major(Core)	2	50	25	25
60232511 /	6.4	Infectious Diseases (Theory)/ Biostatistics (Theory)	Major (Elective)	4	100	50	50
6033251	6.5	Food Chemistry and Nutraceuticals (Theory)	Minor Stream	4	50	25	25
6123253	6.6	Internship In Microbiology dept. in Hospitals/Industry/ Pathological Labs/Multispecialty Clinics	OJT	4	100	25	75
				22	**550**	**250**	**300**

Exit with Degree (3-year) with total 129 credits.

4-Year Degree with Honors

	SN	Courses	Type of Course	Credits	Marks	Int	Ext
		Semester VII					
7013251	7H.1	Molecular Immunology (Theory)	Major (Core)	4	100	50	50
7013251	7H.2	Bioinstrumentation-Techniques and Applications (Theory)	Major (Core)	4	100	50	50
7013252	7H.3	Bioinstrumentation-Techniques and Applications (Practical)	Major (Core)	2	50	25	25
7013251	7H.4	Orientation To Research	Major (Core)	4	100	50	50
70232511 /	7H.5	Microbial Physiology and Development (Theory) / Bioenergetics and Enzymology (Theory)	Major (Elective)	4	100	25	75
7033251	7H.6	Research Methodology in Microbiology	Minor Stream	4	100	50	50
				22	**550**	**250**	**300**
		Semester VIII					
8013251	8H.1	Advanced Clinical Virology	Major (Core)	4	100	50	50
8013251	8H.2	Food Dairy Microbiology and Fermentation process (Theory)	Major (Core)	4	100	50	50
8013252	8H.3	Food Dairy Microbiology and Fermentation process (Practical)	Major (Core)	4	100	50	50
8013251	8H.4	Macromolecules and Enzymology	Major (Core)	2	50	25	25
80232511 /	8H.5	Bioprocess Engineering and Technology / Agriculture Microbiology	Major (Elective)	4	100	50	50
8123253	8H.6	Internship In Hospitals/ Industry/ Pathological Labs/Multispecialty Clinics	OJT	4	100	25	75
				22	**550**	**250**	**300**

4-Year Degree with Research

	SN	Courses	Type of Course	Credits	Marks	Int	Ext
		Semester VII					
7013256	7R.1	Molecular Biology (Theory)	Major (Core)	4	100	50	50
7013251	7R.2	Bioinstrumentation-Techniques and Applications (Theory)	Major (Core)	4	100	50	50
7013252	7R.3	Bioinstrumentation-Techniques and Applications (Practical)	Major (Core)	2	50	25	25
70232511 /	7R.4	Microbial Physiology and Development (Theory) / Bioenergetics and Enzymology (Theory)	Major (Elective)	4	100	50	50
7033251	7R.5	Research Methodology in Microbiology	Minor Stream	4	100	50	50
7163252	7R.6	Research Project	Research	4	100	25	75
				22	**550**	**250**	**300**
		Semester VIII					
8013251	8R.1	Advanced Clinical Virology	Major (Core)	4	100	-	100
8013251	8R.2	Food Dairy Microbiology and Fermentation process (Theory)	Major (Core)	4	100	-	100
8013251	8R.3	Macromolecules and Enzymology	Major (Core)	2	50	-	50
80232511 /	8R.4	Bioprocess Engineering and Technology /Agriculture Microbiology	Major (Elective)	4	100	-	100
8163252	8R.5	Research Project	Major (Core)	8	200	-	200
				22	**550**	**-**	**550**

Course Syllabus

Semester I

1.1 Major (Core)

Course Title	**FUNDAMENTALS OF MICROBIOLOGY (THEORY + PRACTICAL)**
Course Credits	3+1
Course Out comes	After going through the course, learners will be able to
	1. Elucidate the process of formation of earth and evolution of microorganisms on earth. 2. Summarize the key events in the history of microbiology 3. Recognize the scope and relevance of microbiology 4. Recall and explain the nature, correlate function of components that make up a prokaryotic cell and identify them microscopically. 5. Compare between structural features of prokaryotic and eukaryotic cell
Module 1 (Credit1) ***History, Introduction & Scope Of Microbiology***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	Enlist the major events in the history of Microbiology and know the scope of microbiology
Content Outline	• Introduction and discovery of microorganisms, • Scope and relevance of microbiology, • Future of microbiology
Module 2(Credit1) ***Prokaryotic Cell Structure and functions***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	Describe the ultrastructure of the cell.
Content Outline	• Cell wall, Cell membrane, Components external to cell wall- Capsule, Flagella, Pili, Fimbriae, • Cytoplasmic matrix-ribosomes, gas vesicles. Nucleoid, Bacterial endospores and their formation
Module 3 (Credit1)	***Microbial Nutrition, Cultivation, Isolation& Preservation***
Learning Outcomes	After learning the module, learners will be able to:.
(Specific related to the module. e.g., Define, Differentiate, Carry out Design, etc.…)	Recall the characteristics and structures of biomolecules and classify and detect them in various samples

Content Outline	• Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors, • Nutritional types of microorganisms, • Types of Culture media, Isolation of microorganisms and pure

	culture techniques, • Preservation of microorganisms
Module 4 (Credit 1) ***Microorganisms – In the Lab and in Nature***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out Design, etc.…)	Enlist the principles of nutrition, cultivation and preservation of microorganisms.
Content Outline	1. Assignment on contribution of a scientist. 2. Preparation of Culture Media: a) Liquid medium (Nutrient Broth) b) Solid Media (Nutrient agar, Sabourauds agar) c) Preparation of slant, butts and plates 3. Inoculation techniques and Study of Growth: a) Inoculation of Liquid Medium Inoculation of Solid Media (Slants, Butts and Plates) 4. Study of Colony Characteristics of Bacteria and pigmented Bacteria. 5. Study of Motility (Soft agar butt) 6. Use of Differential and Selective Media a) MacConkey agar b) Salt Mannitol Agar 7. Methods of Preservation of culture

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Project work
   a. Composition of cell
   b. Functions of cell
2. Seminar
   a. Sterilization techniques
   b. Equipment's and instrument use in laboratory
3. Quiz
   a. history of microbiology
   b. staining methods

References

1. Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology TMH 5th Edition, 2001.
2. Prescott, Hurley, Klein-Microbiology, 9th edition, International edition, McGraw Hill, 2013.
3. Michael T. Madigan & J. M. Martin, Brock, Biology of Microorganisms 11th Ed. International edition, Pearson Prentice Hall, 2006.
4. Cruikshank, Medical Microbiology, Vol-II, reprint. Publisher, Churchill Livingstone, 1975.
5. Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology, 11th edition McGraw Hill. 2006
6. Tortora, Funke and Case, Microbiology-an Introduction, 10th Edition, Benjamin-Cummings Publishing Company, 2009.
7. M. Madigan, J. Martinko, J. Parkar, "Brock Biology of microorganisms", 12th ed., Pearson Education International, 2009.
8. Tortora G.J. Microbiology: An Introduction, Benjamin Cumming Corp.1st edition, 2008.
9. J.C.H. Steele, Clinics in laboratory medicine, Emerging Infections and their causative agents. vol 24, issue 3, September 2004
10. Ananthnarayan & Paniker, Textbook of Microbiology, 8th edition, 2009
11. Godkar Praful, Medical laboratory technology, 2nd edition, 2006

1.2 Major (Core)

Course Title	**APPLIED MICROBIOLOGY- I (THEORY + PRACTICAL)**
Course Credits	3+1
Course Out comes	After going through the course, learners will be able to
	1. Prepare microbiological media using basic ingredients. 2. Identify the purpose of use of enriched, selective and differential media 3. Select appropriate growth medium or method for experimental work. 4. Apply the knowledge of inoculation methods for isolating a variety of bacteria 5. Study and identify isolates based on features of their colonies formed on solid media. 6. Preserve different types of microbial cultures.
Module 1 (Credit 1) ***Microscopy and Staining***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc.)	Understand different staining procedures used in the study of morphological and structural aspects of bacteria
Content Outline	• **Microscopy -** History of microscopy, Optical spectrum, Lenses and mirrors: Simple and compound light microscope, Dark field Microscopy, • **Staining procedures -**Dyes and stains: Types, Physicochemical basis, Fixatives, Mordants, Decolorizers, Simple and differential staining, Special staining (Cell wall, Capsule, Lipid granules, Spores & Metachromatic granules) • **Biosafety In Microbiology-** Means of laboratory infections, potentially hazardous procedures, Training of personnel, Laboratory procedures.
Module 2 (Credit 1) ***Sterilization and disinfection***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc.)	Illustrate the concepts of aseptic techniques in microbial cultivation and enumeration.
Content Outline	• Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant. • Evaluation of disinfectant –Tube dilution & Agar plate techniques, Phenol coefficient etc., Tissue toxicity index
Module 3 (Credit 1) ***Methods of microbial control***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out,Design etc.)	Differentiate between chemical and physical methods of microbial control

Content Outline	• **Physical methods of microbial control –** i. Dry & moist heat – mechanisms, instruments, uses and their operations

	ii. Electromagnetic radiations – Ionizing radiations, mechanisms – advantages & disadvantages iii. Bacteria proof filters iv. Low temperature v. Osmotic pressure vi. Desiccation • **Chemical methods of microbial control** - mechanism & advantages & disadvantages (if any) applications. a) Phenolics b) Alcohols c) Heavy metals and their compounds d) Halogens e) Quaternary ammonium compounds f) Dyes a) Surfaces active agents/Detergents h) Aldehydes i) Peroxygens
Module 4 (Credit 1) ***Staining Methods & Instrumentation***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc)	Carry out basic staining and culturing techniques and test microbial activities using aseptic techniques.
Content Outline	•Parts of a microscope •Micrometry •Dark field and Phase Contrast Microscopy: (Demonstration) •Monochrome staining •Gram staining •Negative Staining •Nutritional requirements- Designing media using food material •Preparation of standard laboratory Culture Media: a. Liquid medium (Nutrient Broth) b. Solid Media (Nutrient agar, Sabouraud's agar) c. Preparation of slant, butts& plates •Inoculation techniques and Study of Growth: a. Inoculation of Liquid Medium b. Inoculation of Solid Media (Slants, Butts and Plates)

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics – Biosafety, Staining methods, Microscopy
2) Quiz – Staining methods, Microbial control
3) Surprise Test
4) Seminar presentation on any topic

References

1. Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology TMH 5th Edition, 2001.
2. Prescott, Hurley, Klein-Microbiology, 9th edition, International edition, McGraw Hill, 2013.
3. Michael T. Madigan & J.M.Martin, Brock, Biology of Microorganisms 11th Ed. International edition, Pearson Prentice Hall, 2006.
4. Cruikshank, Medical Microbiology, Vol-II, reprint. Publisher, Churchill Livingstone, 1975.
5. Kathleen Park Talaro & Arthur Talaro-Foundations in Microbiology, 11th edition McGraw Hill. 2006
6. Tortora, Funke and Case, Microbiology-an Introduction, 10th Edition, Benjamin-Cummings Publishing Company, 2009.
7. M. Madigan, J. Martinko, J. Parkar, "Brock Biology of microorganisms", 12th ed., Pearson Education International, 2009.
8. Tortora G. J. Microbiology: An Introduction, Benjamin Cumming Corp.1st edition, 2008.
9. J.C.H. Steele, Clinics in laboratory medicine, Emerging Infections and their causative agents. vol 24, issue 3, September 2004
10. Ananthnarayan & Paniker, Textbook of Microbiology, 8th edition, 2009
11. Godkar Praful, Medical laboratory technology, 2nd edition, 2006

1.3 OEC

Course Title	**BASIC CONCEPTS OF IMMUNOLOGY (THEORY)**
Course Credits	4
Course Out comes	After going through the course, learners will be able to
	1. Define immunology and explain its basic concepts 2. Examine the molecules involved in immune effector response and mechanism. 3. Comment on the various components of immune system and their applications in health care 4. Analyse the significance and applications of advanced immuno techniques. 5. Apply the advanced immuno techniques for detection of pathogens.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carryout, Design etc.)	Understand the basic concept of Immune system
Content Outline	• **Introduction** Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa • **Immune Cells and Organs** Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	Identify structure and characteristics of antigens and antibodies
Content Outline	• **Antigens** Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants • **Antibodies** Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:

(Specific related to the module. e.g., Define, Differentiate,	Gain knowledge about complement system and generation of immune response

Carry out, Design etc.)	
Content Outline	• **Major Histocompatibility Complex** Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways) • **Complement System** Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation • **Generation of Immune Response** Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co-stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc)	Identify immunological disorders using immunological techniques
Content Outline	• **Immunological Disorders and Tumor Immunity** Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers. • **Immunological Techniques** Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics :Immunological Disorders,Immunological Techniques
2) Quiz : Types of immunity, Antigen and Antibody reaction
3) Surprise Test
4) Seminar presentation on any topic

References

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
6. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwell Scientific Publication, Oxford.
7. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
8. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

1.4 VSC

Course Title	**BASIC SKILLS OF MICROBIOLOGY LABORATORY (Practical)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	1. Handle microscope, autoclave, biosafety cabinets, incubator etc. 2. Prepare sterile zone for working in laboratory 3. Perform analysis of air, water and pharmaceutical preparations. 4. Evaluate effect of various factors affecting microbial growth.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	• Enlist the basic microbiology laboratory rules and good laboratory practices (GLP), principles of sterility, sterile zone and working in sterile zone. • Identify different parts of microscope and handling of microscope
Content Outline	• Microbiology Good Laboratory Practices and Biosafety. • Introduction to microscope and study of different aspects of microscope. • Preparation of sterile zone in the lab, working in aseptic area (between two burners) with precautions. • To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory. • Microbiological analysis of air, water and some pharmaceutical preparations.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	Study the isolation, purification and characterization of microorganisms and understand factors affecting growth of microbes
Content Outline	• Measurement of size of microorganisms. • Counting the number of microorganisms/ml of the culture • Determination of Thermal Death Time • Factors affecting growth of organisms like temperature and pH. • Isolation of colonies, purification techniques and observation of colony characteristics using spread plate, pour plate and serial dilution methods.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Rules to be followed in Microbiology Laboratory
   Good laboratory practices
2) Quiz: Microscope, different parts of microscope and their applications
3) Surprise Test
4) Seminar presentation on any topic

References:

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP (2014). Brock Biology of Micro-organisms. 14th edition. Pearson Education, Inc.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Tortora GJ, Funke BR and Case CL. (2008). Microbiology:An Introduction.9th edition, Pearson Education.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

1.5 SEC

Course Title	**BASIC CONCEPTS IN IMMUNOLOGY (Practical)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	• Understand the basic concepts of immunology • List various principles involved in immunology
Module 1 (Credit 1)	**Principles and techniques of Immunology**
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	• Differentiate the precipitation and agglutination reactions using suitable examples and effectively determine various tests used for detection of antigens.
Content Outline	1. WIDAL test – Qualitative & Quantitative 2. ELISA (Kit based). 3. Dot ELISA 4. Single radial immunodiffusion 5. Ouchterlony's double immunodiffusion 6. Study of Abnormal Karyotyping (Chromosomal Aberration) - Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21, Trisomy 13, Trisomy 18, Klinefelter, Turner and Cri-du-Chat. (By usage of Software)
Module 2 (Credit 1) Applications of Immunotechniques	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	• Analyse the significance and applications of advanced immuno techniques. • Apply the advanced immuno techniques for detection of pathogens.
Content Outline	1. Video demonstration of G- banding 2. Induction of Polyploidy by PDB/ Colchicine/ UV Treatment Using Suitable Plant material 3. Study of Polytene Chromosomes 4. Mapping based on Tetrad Analysis and Three Point Cross. 5. Pedigree Analysis- Autosomal and Sex- Linked.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Different Immunology Techniques
2) Quiz: Applications of advance Immunotechniques
3) Surprise Test
4) Seminar presentation on any topic

References:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

1.6 AEC

Course Title	**COMMUNICATION SKILL, CRITICAL READING (THEORY)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	1. Understand the behavioural needs to function effectively 2. Communicate effectively (Verbal and Nonverbal) 3. Effectively manage the team as a team player 4. Develop interview skills 5. Develop Leadership qualities and essentials
Module 1 (Credit 1) ***Introduction***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module.e.g., Define, Differentiate, Carry out, Design, etc….)	Understand Basics of communication skills
Content Outline	• **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context • **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers • **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment • **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication • **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style
Module 2 (Credit 1) Different ways of Communication Skills	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	Study basic listening skills and effective written communication

Content Outline	• **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations • **Effective Written Communication:** Introduction, When and When Not to Use Written

	• Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication • **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message • **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview • **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery • **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Flow chart of communication process
2) Role Play : Communication with professionals
3) Surprise Test
4) Seminar presentation on any topic

References:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, McGraw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

1.7 IKS

Course Title	Introduction to Ancient System of Medicine
Course Credits	2
Course Outcomes	After going through this course, learners will be able to
	1. Explain various ancient systems of medicine 2. Retrieve the history behind diagnostic techniques 3. Review ancient techniques, procedures and equipment used for diagnosis of diseases
Module 1 (Credit1)	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry ,Design ,etc.…)*	After learning the module, learners will be able to
	1. Gain knowledge about Origin of Ayurveda, Siddha Medicine and Unani Medicine
Content Outline	• Introduction and review of Ancient Diagnostic methods e.g. Ayurveda, Siddha and Unani medicine
Module 2 (Credit 1)	
Learning Outcomes *(Specific related to the module. e.g. Define, Differentiate, Carry ,Design ,etc.…)*	After learning the Module, learner will be able to
	1. 1.Understand about Allopathy Medicine
	2. Learn about Homeopathy Medicine
Content Outline	• Different methods used to diagnose pathological conditions in Allopathy Medicine • Methods and techniques of diagnosis used in Homeopathy Medicine

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Different ancient medical systems and its history
2) Quiz: Important features of Ayurveda, Siddha and Unani Medicine
3) Surprise Test
4) Seminar presentation on any topic

References

1. The origins of the history and Physical examination by HK Walker3rd edition Butterworths publishers
2. A Brief history of medical diagnosis and birth of the clinical laboratory by D Berger cited by 150- diagnosis by water casting
3. A historical perspective on the Clinical Diagnostic Laboratory by RE Moore 2nd edition published by Humana press
4. Charak Samhita by Maharshi Charak English translation by P.V.Sharma 2017, Public library of India

1.8 VAC

Course Title	**ENVIRONMENTAL SCIENCE-I (THEORY)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	1. Create the awareness about environmental problems among learners. 2. Impart basic knowledge about the environment and its allied problems. 3. Develop an attitude of concern for the environment. 4. Motivate learner to participate in environment protection and environment improvement. 5. Acquire skills to help the concerned individuals in identifying and solving environmental problems. 6. Strive to attain harmony with Nature
Module 1 (Credit 1) ***The Multidisciplinary nature of environmental studies***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	Understand conservation of natural resources
Content Outline	• Natural Resources • Renewable and non-renewable resources: • Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design,etc.)	Understand the concept of ecosystem
Content Outline	• Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features, structure and function of the ecosystems: • Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) • Environmental Pollution: Air pollution; Water pollution; Soil pollution.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Natural resources and environmental problems
2) Quiz: Structure and functions of Ecosystems
3) Surprise Test
4) Seminar presentation on any topic

References:

1) Fundamentals of Environmental Studies for UG course by Dr. Sarita Kumar 2021st edition, edited by SCS Sultan Chand
2) Environmental studies, V K Ahluwalia. Second edition by 'teri' The Energy and Resources Institute
3) Text Book of environmental studies by Dr. D.K. Asthana and Meera Asthana. Edition by S. Chand and company Ltd.

1.9 CC

Course Title	**Yoga and Personality Development**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Perform basic yoga poses and understand the yoga philosophy
	2. Acquire skills for developing professional and personal mannerisms and act confident
Module 1(Credit1)	
Learning Outcomes *(Specific related to the module. e.g. Define, Differentiate, Carry ,Design ,etc.…)*	After learning the module, learners will be able to
	1. Perform breathing and meditation techniques as well as poses
	2. Apply basic yoga principles in day to day life
Content Outline	• Introduction to Yoga • Different yoga poses and its principles • Meditation and breathing techniques
Module 2(Credit1)	
Learning Outcomes *(Specific related to the module.. e.g. Define, Differentiate, Carry ,Design ,etc.…)*	After learning the module, learners will be able to
	1. Identify their goals and make strategies to achieve them **2.** Develop confidence with improving the communication skills professionally and personally and develop sense of self awareness, hygiene and time management
Content Outline	• Self-Awareness and hygiene • Public speaking (effective interview techniques) • Self-esteem and positive attitude • Time management

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on topics: Self-awareness on health and hygiene
2) Quiz: Time management
3) Unit tests for theory (Personality Development)
4) Continuous assessments for Practical (Yoga)

References

1 You Can Win by Shiv Khera by bloomsburry publication 2023 edition

2 The magic of Thinking big by David J. Schwartz

3 The seven habits of highly effective people by Stephen R. Covey 30th edition Simon and Schuster

4 Falling Forward: Turning mistakes into stepping stones for success by John C.Maxwell

5 The power of a positive attitude by Roger Fritz

Course Syllabus

Semester II
2.1 Major (Core)

Course Title	**FUNDAMENTALS OF MICROORGANISM (THEORY + PRACTICAL)**
Course Credits	3+1
Course Out comes	After going through the course, learners will be able to
	• Study different types of microorganisms and their structural aspects. • Outline various types of microbial interactions. • Enlist the microorganisms present in different parts of human body. • Learn about microbial association with plants.
Module 1 (Credit1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	Study different types of microorganisms and their structural aspects
Content Outline	**Study of Different Groups Of Microbes** Study of following microorganisms with respect to Classification, Morphological characteristics, cultivation, reproduction and significance: • **Algae -** Characteristics of algae: morphology, Pigments, reproduction Cultivation of algae. Major groups of Algae –an overview. Biological, Medical and economic importance of Algae. Differences between Algae and Cyanobacteria • **Fungi and Yeast-** Characteristics: structure, Reproduction, Cultivation of fungi and yeasts. Major fungal divisions- overview. Life cycle of yeast Biological and economic importance
Module 2 (Credit1) ***Prokaryotic Cell Structure and functions***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	Outline various types of microbial interactions.

Content Outline	**Study Of Different Groups Of Microbes** • **Viruses**: a) Historical highlights, General properties of viruses, prions, viroids b) Structure of viruses-capsids, envelopes, genomes, c) Cultivation of viruses- overview d) Bacteriophages: Lytic cycle. Lysogeny, Structure and Life cycle of T4 phage. **Microbial Interaction** • **Types of Microbial Interactions -** Mutualism, Cooperation, Commensalisms, Predation Parasitism, Amensalism, Competition (Definition with one example)

Module 3 (Credit1)	
Learning Outcomes	After learning the module, learners will be able to:.
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	• Enlist the microorganisms present in different parts of human body. • Understand microbial association with plants.
Content Outline	• **Human Microbe Interactions**. a) Normal flora of the human body: Skin, Nose & nasopharynx, oropharynx, respiratory tract, eye, external ear, Mouth, stomach, small intestine, large intestine, genitourinary tract b) Relationship between microbiota & the host. c) Gnotobiotic animals • **Microbial associations with vascular plants** a) Phyllosphere b) Rhizosphere & Rhizoplane c) Mycorrhizae d)Nitrogen fixation: Rhizobia, Actinorhizae, Stem Nodulating Rhizobia e) Fungal & Bacterial endophytes f) Agrobacterium & other plant pathogens
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out Design, etc.…)	Identify different types of microorganisms using staining techniques and wet mount preparations
Content Outline	1. Spot assay and plaque assay of Bacteriophage (Demonstration) 2. Slide Culture technique (& Fungal Culture) 3. Isolation of yeast. 4. Cultivation on other fungi Sabourauds agar. 5. Static & Shaker Cultures. 6. Fungal Wet mounts & Study of Morphological Characteristics of fungi: *Mucor, Rhizopus, Aspergillus, Penicillium.* 7. Preparation of permanent slides of Algae. 8. Normal flora of the Skin & Saliva. 9. Wet Mount of Lichen. 10. Bacteroid Staining & Isolation of Rhizobium. 11. Azotobacter isolation & staining.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on given topic: Different normal flora on human body
2) Quiz: Different staining techniques
3) Surprise Test
4) Seminar presentation

References:

1. Michael J. Pelczar Jr., E.C.S. Chan ,Noel R. Krieg, Microbiology TMH 5th Edition, 1998
2. Prescott, Hurley, Klein-Microbiology,9th edition, International edition, McGraw Hill, 2013.
3. Michael T. Madigan & J. M. Martin, Brock, Biology of Microorganisms 11th Ed. International edition, Pearson Prentice Hall, 2006
4. Cruikshank, Medical Microbiology, Vol-II, reprint. Publisher, Churchill Livingstone, 1975.
5. Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology, 11th edition McGraw

Hill. 2006

6. Tortora, Funke and Case, Microbiology an Introduction, 10th Edition, Benjamin-Cummings Publishing Company, 2009.
7. M. Madigan, J. Martinko, J. Parkar, "Brock Biology of microorganisms", 12th ed., Pearson Education International, 2009
8. Tortora G. J. Microbiology: An Introduction, Benjamin Cumming Corp.1st edition, 2008.
9. *J.C.H. Steele,* Clinics in laboratory medicine, Emerging Infections and their causative agents. vol 24,issue 3, September 2004
10. Ananthnarayan & Paniker, Textbook of Microbiology, 8th edition 2009
11. Godkar Praful, Medical laboratory technology, 2nd edition. 2006

2.2 Major (Core)

Course Title	**APPLIED MICROBIOLOGY II (THEORY + PRACTICAL)**
Course Credits	3+1
Course Out comes	After going through the course, learners will be able to
	• Designate various factors affecting infections caused by microorganisms. • Enlist the pathways of host defence against microbial infections
Module 1 (Credit1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	• Study various factors affecting infections caused by microorganisms. • Outline various mechanisms of microbial drug resistance.
Content Outline	**Microbes and Human health** • **Difference between infection & disease-**Important terminology: Primary infection, secondary infection. Contagious infection, occupational disorder, clinical infection, subclinical infection, Zoonoses, genetic disorder, vector borne infection. • **Factors affecting infection -** a) Microbial factors: adherence, invasion, role of virulence factors in invasion, colonization & its effects. b) Host factors: natural resistance, species resistance, racial resistance. • **Individual resistance**: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic. • **Host defense against infection: Overview** a) First line of Defense: for skin, respiratory tract, gastrointestinal tract, genitourinary tract, eyes. b) Second line of infection: Biological barriers: Phagocytosis, Inflammation c) Third line of infection: Brief introduction to antibody mediated & cell mediated immunity
Module 2 (Credit1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Desig, etc)	• Enlist the pathways of host defence against microbial infections. • Understand the working of different types microbiological instruments

Content Outline	**Advanced Techniques In Microbiology & Instrumentation** • Electron Microscope: TEM, SEM, • Contrast enhancement for electron microscope • Fluorescent Microscope, Confocal Microscope • pH meter, pH meter Validation and calibration • Colorimeter

	• Validation and calibration of Auto clave & Hot air Oven • Concepts: Laminar air flow systems, Biosafety cabinets, Walk-in Incubators, Industrial autoclaves, Cold Room

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on given topic: Different dseases and different types of infections
2) Quiz: Advanced tecniques in Microbiology and Instumentation
3) Surprise Test
4) Seminar presentation

References

1. Michael J. Pelczar Jr., E.C.S. Chan, Noel R. Krieg, Microbiology TMH 5th Edition, 1998
2. Prescott, Hurley, Klein-Microbiology,9th edition, International edition, McGraw Hill, 2013.
3. Michael T. Madigan & J. M. Martin, Brock, Biology of Microorganisms 11th Ed. International edition, Pearson Prentice Hall, 2006
4. Cruikshank, Medical Microbiology, Vol-II, reprint. Publisher, Churchill Livingstone, 1975.
5. Kathleen Park Talaro & Arthur Talaro - Foundations in Microbiology, 11th edition McGraw Hill. 2006.
6. Tortora, Funke and Case, Microbiology an Introduction, 10th Edition, Benjamin-Cummings Publishing Company, 2009.
7. M. Madigan, J. Martinko, J. Parkar, "Brock Biology of microorganisms", 12th ed., Pearson Education International, 2009
8. Tortora G. J. Microbiology: An Introduction, Benjamin Cumming Corp.1st edition, 2008.
9. J.C.H. *Steele,* Clinics in laboratory medicine, Emerging Infections and their causative agents. vol 24,issue 3, September 2004
10. Ananthnarayan & Paniker, Textbook of Microbiology, 8th edition 2009
11. Godkar Praful, Medical laboratory technology, 2nd edition. 2006

2.3 Minor Stream

Course Title	**GENERAL CHEMISTRY (THEORY)**
Course Credits	4
Course Out comes	After going through the course, learners will be able to
	1. Draw and explain the structures of various molecules or ions based on the concept of ionic and covalent bonding 2. Explain the Rate Law of a Chemical Reaction and Apply the knowledge of principles like Hammonds postulate, Reactivity and Selectivity Microscopic reversibility to predict the nature of reaction and product formation rate 3. Differentiate the types of catalytic reactions and explain the role of catalyst 4. Classify electrolytes/ elements and elaborate their physiological role. 5. Explain use of physiological ions in replacement therapy, acid-base balance and combination therapy.
Module 1 (Credit 1): Introduction to General Chemistry	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design etc)	Define and identify the structures of various molecules or ions, types of bonds
Content Outline	**1. Review of basic bonding concepts:** Quantum numbers, atomic orbitals, electron configuration, electronic diagrams, polar covalent bonds, electronegativity group, electronegativities, electrostatic potential surfaces, inductive effects, bond dipoles, molecular dipoles • Lewis structures, formal charge. • VSEPR, hybridization involving s, p and d orbitals, hybridization effects **2. Kinetics and reaction mechanism** • Energy surfaces, reaction coordinate diagrams, activated complex/transition state rate and rate constants, reaction order and rate laws • Kinetic isotope effects • Hammond Postulate, reactivity vs selectivity, Curtin-Hammett Principle, microscopic reversibility, kinetic vs thermodynamic control **3. Catalysis:** • General principles of catalysis, Forms of catalysis – electrophilic catalysis, acid- base catalysis, nucleophilic catalysis, covalent catalysis, phase transfer catalysis. • Bronsted Acid-base catalysis, correlation of reaction rates with acidity functions.
Module 2 (Credit 1) Intra & Extracellular Electrolytes, Essential and Trace Elements	
Learning Outcomes	After learning the module, learners will be able to:

(Specific related to the module. e.g., Define, Differentiate,	Classify electrolytes/ elements and elaborate their physiological role

Carry out, Design etc)	
Content Outline	**1.** Major physiological ions (Role and condition related to change in concentration of following ions: chloride, phosphate, bicarbonate, sodium, potassium, calcium, magnesium) **2.** Electrolytes used in replacement therapy: Sodium replacement (sodium chloride), potassium replacement (potassium chloride), calcium replacement (calcium chloride, calcium gluconate) **3.** Physiological acid base balance: Acids and Bases: Buffers (Pharmaceutical and Physiological) Electrolytes used in acid base therapy (sodium acetate, sodium bicarbonate, sodium biphosphate, sodium citrate, sodium lactate, ammonium chloride). Electrolyte combination therapy. Electrolytes used in replacement therapy: Sodium replacement (sodium chloride), potassium replacement (potassium chloride), calcium replacement (calcium chloride, calcium gluconate) **4.** Iron and haematinics, Copper, zinc, molybdenum, selenium and sulphur. Official iodine products (iodine,potassium iodide, sodium iodide)

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on given topic: Structures of various molecules or ions
2) Quiz: Basic bonding concepts
3) Surpise test
4) Seminar presentation

References

1) Eric V Ansyln and Dennis A Dougherty, Modern Physical Organic Chemistry, John Wiley.
2) Inorganic medicinal and pharmaceutical chemistry, J. H. Block, E. B. Roche, T. O. Soine, and C. O. Wilson. Lea &Febiger, Philadelphia, PA.
3) Modern Inorganic Pharmaceutical Chemistry, Clarence A. Discher. Wiley, New York.
4) Remington: the science and practice of pharmacy, Beringer, P. Lippincott Williams & Wilkins.
5) Inorganic Pharmaceutical Chemistry, Bothara, K. G., Nirali Prakashan. 6) Inorganic Pharmaceutical Chemistry, A. S. Dhake, H. P. Tipnis, Career Publication.

2.4 OEC

Course Title	**FERMENTATION TECHNOLOGY (Theory)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	1. Understand and explain the significance of microbes in fermentation industry and compare the techniques used for their screening 2. Compare different types of fermentations and fermentation processes used for industrial productions 3. Exemplify components used in industrial fermentation media with an understanding of its role in the process 4. Establish principles underlying design of Fermenter and Fermentation Process.
Module1 (Credit1) ***Strains Of Industrially Important Microorganisms And Types Of Fermentations***	
Learning Outcomes *(Specific related to the module.e.g., Define, Differentiate, Carry out, Design, etc.…)*	After learning the module, learners will be able to:
	1. Understand the significance of different microbes, desirable characteristics of industrial strains and different fermentation processes.
Content Outline	• Desirable characteristics of an industrial strain • Principles and methods of primary and secondary screening • Aerobic • Anaerobic • Solid state fermentation
Module2(Credit1) ***Types Of Fermentation Processes And Media For Industrial Fermentations***	
Learning Outcome *(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.)*	After learning the module, learners will be able to: Establish principles underlying design of Fermenter and Fermentation Process.
Content Outline	• Surface and Submerged • Batch, continuous, fed-batch fermentation • process • Production and Inoculum media • Media components: - Carbon source, nitrogen source, amino acids and vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on given topic: Different types of fermentation and Fermetation process
2) Quiz: Methods of screening of microbes
3) Surpise test
4) Seminar presentation

References

1. Industrial Microbiology- A. H. Patel
2. Industrial Microbiology- L. E. Casida- John Wiley & Sons
3. Microbiology–6th Edition (2006), Pelczar M.J., Chan E.C.S., Krieg N.R., The McGraw Hill Companies Inc. NY
4. Presscott's Microbiology, 8th edition (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton, McGraw-Hill Science Engineering, USA

2.5 VSC

Course Title	**Food fermentation techniques (Practical)**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Define different types of fermented foods
	2. Differentiate the types of fermented foods
	3. Identify various advantages and health benefits of fermented foods
	4. Identify various types of microorganisms involved in fermented foods
Module 1 (Credit 2)	
Learning Outcomes	After learning the module, learners will be able to
(Specific related to the module.. e.g. Define, Differentiate, Carry out, Design, etc.…)	• Study and understand the role played by microorganisms in food spoilage, preservation & production. • Evaluate the microbiological quality of milk, study preservation of milk, production of cheese. • Understand the functioning of microbial industrial fermentations.
Content Outline	1. Microbial fermentation for the production and estimation of amylase 2. Microbial fermentation for the production and estimation of citric acid 3. Microbial fermentation for the production and estimation of ethanol
Module 2 (Credit 2)	
Learning Outcomes	After learning the module, learners will be able to
(Specific related to the module. e.g. Define, Differentiate, Carry out, Design, etc.…)	• Determination of the microbiological quality of milk sample by MBRT • Isolation of fungi from spoilt bread/fruits/vegetables
Content Outline	1. Preparation of Yogurt/Dahi 2. Grading of Milk, DMC, Dye reduction test, Phosphatase test, SPC, LPC, 3. Coliform, psychrophilic and thermophilic counts in milk and milk products 4. Visit to a food industry/dairy unit / fermentation industry.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Poster presentation on given topic: Health benefits of Fermented food
2) Quiz: Methods of screening of microbes in fermented food
3) Surprise test
4) Seminar presentation

References

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

2.6 SEC

Course Title	**Computer Applications (THEORY)**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	• Study application of computers, types of computers computer hardware, computer code and arithmetic's, softeware component and data processing concepts • Enable the learners to understand concept basic anatomy of computers, central processing unit input and output device. • Enable the learners to understand in detail about Binary number system computer logic software component
Module 1	
Learning Outcomes *(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.)*	After learning the module, learners will be able to:
	Study basics of computers, present and future application of computer, types of computers and it's software and hardware.
Content Outline	• **Introduction:** Introduction to computers • **Historical development:** Present and future application of computers in everyday life and scientific research. • **Types of computers:** Mini, Micro, Mainframe, and Supercomputers. • **Computer hardware:** Components, Basic anatomy of computers, Central Processing Unit, Control Unit, Arithmetic Logic Unit, Memory devices, Input Devices, Output devices, Secondary storage devices. • **Computer codes and arithmetic's:** Binary number system, Fixed point and floating point numbers, Character data representation, ASCII codes, Computer logic, Boolean algebra, Truth tables, Logic gates. • **Software Components:** System software, Machine language, High-level languages. • **Data Processing Concepts :** Types of data processing , Online processing ,Time –sharing
Module2 (Credit1)	
Learning Outcomes *(Specific related to the module. e.g., Define, Differentiate, Carry out Design, etc.…)*	**To study the concepts of computer connectivity, MS Office, internet and web.**

Content Outline	• **Application software :** General purpose application, Word processors, Spread sheets, Database Management Systems, Presentation graphics, Software suits, Integrated packages. • **Communication and Connectivity** : Fax-machines, E-mail, Voice messing systems, Videoconferencing systems, Shared resources, Online services, User connection, Modems, Types of modems, Type connections, Communication channels, Telephone lines, Coaxil cable, Fiber optics cable ,Microwave,

	Satellite, Data transmission, Network architecture, Network types. • **The Internet and the Web :** Internet applications, Access, E-mail, E-commerce, Internet services, Browsers, Web pages, Search tools, Web utilities,, Organizational internets, Interanets and extranets. • **Multimedia and Web Authoring :** Multimedia ,Web authoring, Graphic programs, Virtual reality, Artificial intelligence, Project management • **Microsoft Word :** Application of Microsoft word • **Microsoft Excel/Analysis :** Use of Microsoft excel of preparation of data sheet, • **Microsoft Power Point:** Application of power point • **Statistical analysis :** Statistical application t-test, Regression Analysis, ANOVA

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Power point presentation on given topic: Use of particular software
2. Flow chart making: Different types of computers
3. Seminar presentation on the given topic

References

1. Introduction to computers by Satish Sahani
2. Computer Programs in Clinical and Laboratory Medicine by D John Doyle
3. Computer application by Sumita Arora
4. Introduction to computer application by Dr Mauparna Nandan, Dr Ajay Sharma

2.7AEC

Course Title	**COMMUNICATION SKILLS IN ENLISH (THEORY)**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	• Develop the ability to speak and write grammatically correct English. • Understand in detail various tenses, clauses, methods of presentation, discussion and debating, scientific report and how to face the interview.
Learning Outcomes *(Specific related to the module. E.g., Define, Differentiate, Carry out, Design, etc.…)*	After learning the module, learners will be able to:
	Develop the ability to speak and write grammatically correct English.
Content Outline	**1. Applied Grammar** • Remedial study of grammar, Review of grammar and vocabulary. Effective use of dictionary, Phonetics. • Conditionals/Tenses, relative clauses, subject–verb agreement, passive voice • Consulting a dictionary for correct pronunciation (familiarity with phonetics symbols and stress-marks only) • **Dialogue:** Oral report, discussion, lecture/seminar, debate, telephonic conversation. • **Soft Skills/Non-verbal communication:** Gestures/ postures – Body language, gesture, posture.
Module2(Credit1) *)*	
Learning Outcomes *(Specific related to the module. E.g., Define, Differentiate, Carry out Design, etc.…)*	Comprehend and learn about the written communication skills.
Content Outline	**Reading Comprehension and Discussion:** i. To read and comprehend selected materials, articles, magazines, journals related to pharmacy. ii. How to Analyze, Comment, Argue, Reflect and Persuade the read material. iii. Discuss a topic of general interest, but related to science in about 300 words. (Analyze, comment, argue, reflect, persuade, etc.) • **Scientific Writing:** Writing a Scientific Report on a project undertaken or an experiment conducted (theory + practice). • **Other Forms of Written Communication:** i. Letter writing, note taking, precise writing, essay writing, anecdotal records, diary writing, reports. Resume/ curriculum vitae and the likes.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1) Open discussion on the given topic: Role play :Telephonic conversation
2) Quiz: Grammar and vocabulary
3) Unit test : Formal letter writing, Scientific writing

References

1Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
2.Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011
3.Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
4.Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
5. Soft skills and professional communication, Francis Peters SJ, 1stEdition, McGraw Hill Education, 2011
6. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009

2.8 IKS

Course Title	**MICROBIAL DISEASES AND TRADITIONAL KNOWLEDGE OF MEDICINES (THEORY)**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Recognize different types of microbial diseases
	2. Illustrate various pathogenic microorganisms causing diseases
	3. identify different types of traditional medicines
	4. summarize treatments used in ancient system of medicine
Module1(Credit1) Microbial Pathogenesis in Traditional Medicinal systems	
Learning Outcomes *(Specific related to the module. E.g., Define, Differentiate, Carry out,Design, etc.…)*	After learning the module, learners will be able to:
	Learn about Microbes and components causing infections
	Study host and pathogen interactions in context to traditional systems
Content Outline	• Exposure of microbes • Adhesion of microbes • Different invasion modes of microbes • Process of microbes causing infection
Module 2 (Credit1) Traditional Medicinal methods	
Learning Outcomes *(Specific related to the module. E.g., Define, Differentiate, Carryout, Design, etc.…)*	After learning this module, learners will be able to learn: • Different ancient diagnostic methods in Ayurveda medicine • Different ancient diagnostic methods in Siddha medicine • Different ancient diagnostic methods in Unani medicine
Content Outline	Ancient methods of diagnostic procedures in Ayurveda, Siddha and Unani medicine.

Assignments/ActivitiestowardsComprehensiveContinuousEvaluation(CCE)

1) Poster presentation on given topic
2) Quiz
3) Surprise Test
4) Seminar presentation

References

1) The origins of the history and physical examination by HK Walker 3rd edition Butterworths publishers
2) A Brief history of medical diagnosis cited by 150 water casting
3) Charak Samhita by Maharshi Charak English translation by P V Sharma 2017, Public library of India

2.9 CC

Course Title	**DIET & NUTRITION**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1.
Module 1: (Credit 1)	
Learning Outcomes *(Specific related tothe module.. e.g. Define, Differentiate, Carry out, Design, etc.)*	After learning the module, learners will be able to
Module 2 : (Credit 1)	
Learning Outcomes *(Specific related tothe module. e.g. Define, Differentiate, Carry out, Design, etc. …)*	After learning the module, learners will be able to
Content Outline	

Minor Stream

Course Title	**BIOCHEMISTRY- I (THEORY)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	1. Understand the classification, structures, biological significance of biomolecules - carbohydrates, proteins & lipids which forms the foundation of Biochemistry. 2. Describe the chemistry that governs physical, chemical properties and reactions of carbohydrates, proteins and amino acids & lipids. 3. Comprehend the classification and structures of several monosaccharides, disaccharides and polysaccharides, and explain their functions. 4. Elucidate the structures of amino acid, peptide bond formation and classes of amino acids, identify the four levels of protein structure and summarize the function for a range of proteins. 5. Categorize lipids, identify structure and functions of fats, phospholipids and cholesterol, and explain the structural differences between saturated, monounsaturated and polyunsaturated fatty acids with the functional implications.
Module 1 (Credit 1) ***Biomolecules: Carbohydrates, Proteins, Lipids***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	• Classify biomolecules - carbohydrates, proteins & lipids and elaborate their significance
Content Outline	**Carbohydrates** Families of monosaccharides and Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Disaccharides; concept of reducing and non-reducing sugars, Polysaccharides, storage polysaccharides, Structural Polysaccharides, Qualitative tests and biological role of carbohydrates **Lipids** Definition and major classes of lipids. Fatty acid structure and functions. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine,

	Sphingolipids: building blocks, Lipid functions **Proteins** Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion, Classification, biochemical structure and notation of standard protein amino acids Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins. Forces holding the polypeptide together. Human haemoglobin structure, Quaternary structures of proteins
Module 2 (Credit 1) ***Biomolecules- Enzymes, Nucleic Acids and Energetics***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	
Content Outline	**Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes, Structure of enzyme: Apoenzyme and cofactors, Classification of enzymes, Mechanism of action of enzymes, Lock and key hypothesis, and Induced Fit hypothesis, Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples, Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions. **Nucleic acids** Definition, purine and pyrimidine bases, Components of nucleosides and nucleotides with Examples, Structure of DNA (Watson and Crick model), RNA and their functions, DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors. **Bioenergetics** First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy and mathematical relationship among them, Concept of free energy, endergonic

	and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds and its biological significance: Phosphoenolpyruvate, 1, 3- Bisphosphoglycerate, Thioesters, ATP

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

4) Poster presentation on given topic
5) Quiz
6) Surprise Test
7) Seminar presentation

References

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U. Chakrapani
5. Textbook of Biochemistry by Rama Rao. 6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf

Course Title	**APPLIED ASPECTS OF MICROORGANISM (THEORY)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	Create the awareness about studying microbes, several fields of applied microbiology such as. medical microbiology, food microbiology, pharmaceutical microbiology, industrial microbiology, dairy microbiology, microbial technology, agriculture microbiology, soil, microbiology, plant microbiology, veterinary microbiology and environmental microbiology
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	•
Content Outline	• **Medical Microbiology** • **Food Microbiology** • **Pharmaceutical Microbiolgy** • **Industrial Microbiology** • **Dairy Microbiolgy** • **Microbial Technology**
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	
Content Outline	• **Agricultural Microbiology** • **Plant Microbiology** • **Veterinary Microbiolgy** • **Environmental Microbiology** • **Soil Microbiology**

Course Title	**Food Microbiology (THEORY)**
Course Credits	2
Course Out comes	After going through the course, learners will be able to
	4.
Module 1 (Credit 1) ***Introduction and Food as a substrate for microbial growth***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	•
Content Outline	• **Introduction:** Significance, food as a substrate and sources of microorganisms in food • **Food as a substrate for microbial growth:** Intrinsic and extrinsic parameters that affect microbial growth in food Microbial spoilage of food - milk, egg, bread and canned foods • **Methods of detection of microorganisms in food:** Overview of cultural, microscopic, physical, chemical and bioassay methods
Module 2 (Credit 1) ***Principles and methods of food preservation and food sanitation***	
Learning Outcomes	After learning the module, learners will be able to:
(Specific related to the module. e.g., Define, Differentiate, Carry out, Design, etc.…)	
Content Outline	• **Physical methods** - high temperature, low temperature, irradiation, aseptic packaging • **Chemical methods** - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite • **Food sanitation and control** – HACCP • **Food borne diseases**