

JSS Academy of Higher Education & Research

(Deemed to be University)

Re-Accredited "A+" Grade by NAAC

Sri Shivarathreeshwara Nagara Mysuru - 570015, Karnataka

Faculty of Life Sciences

Syllabus

B.Sc. MICROBIOLOGY
As Per National Education Policy 2020
Under the CBCS Pattern
Implementation Year 2021-22 onwards

BSc

Syllabus

B.Sc. MICROBIOLOGY **As per NEP 2020**

Under the CBCS Pattern



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B.Sc Microbiology

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B.Sc. Microbiology

Program Objectives:

Microorganisms are ubiquitous in the biosphere. Life on earth sustains on the activities of microbes which imparts a huge influence on human society. Hence, the study of Microbiology has an impact in diverse fields such as agriculture, industry, medicine, food sciences, ecology, genetics, biochemistry, molecular biology, and others. The course is designed based on basics to applied microbiological knowledge. The stakeholders on completion of graduation, will be able to acquire, understand, analyse, and apply the concepts and knowledge relevant to myriad microbiological fields. They will gain practical knowledge of laboratory safety and hands-on training of routine and specialized microbiological skills.

Specific objectives of the Program are outlined below:

- To impart the knowledge of basic principles of microbiology, microbial diversity, cell biology, biochemistry, genetics, immunology and applied aspects of food, agricultural, medical, and industrial microbiology.
- To expose the students to laboratory diagnostic techniques, epidemiology, transmission, prevention, and control of diseases.
- To prepare the students to observe and analyze theoretical and practical concepts and communicate scientific ideas effectively.
- To enable the students to be eligible for higher studies, placements, and entrepreneurship endeavours in various sectors.

Program Outcomes:

On successful completion of the undergraduate program (Basic/Hons) in Microbiology, the students would have acquired the competent skills to pursue professional career in various Microbiology sectors such as food/pharmaceutical/medical/clinical/agricultural, and biotechnological set-ups. The students can pursue higher studies/ research in specialized fields of Microbiology. The students will be equipped to undertake entrepreneurial ventures.

Program Specific Outcomes:

Competencies need to be acquired by the candidate securing B.Sc., (Basic) or B.Sc., (Hons)

At the end of the program, the learners will be able to:

1. Gain the knowledge of the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microbes including isolation, identification, and maintenance.
2. Explore the microbial world and analyze its roles, benefits and challenges.

3. Describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations.
4. Understand the biochemical and physiological aspects of microorganisms and develop broader perspective to identify innovative solutions for present and future challenges posed by microorganisms.
5. Demonstrate the ability to identify ethical issues related to recombinant DNA technology, GMOs, intellectual property rights, biosafety and biohazards.
6. Enhance and demonstrate analytical skills and apply basic computational and statistical techniques in the field of Microbiology.
7. Learn and practice professional skills with hygienic practices in laboratories and production sectors.
8. Understand the concepts of Microbiology and its application in pharma, food, agriculture, beverages, and nutraceutical industries.
9. Apply the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors and to conserve the environment and to resolve the environment related issues.
10. Demonstrate the ability to identify the key questions in Microbiological research, optimize research methods, analyze outcomes by adopting scientific methods, and thereby improving the employability.

Eligibility

Candidates who have passed the 10+2 Examination/ Equivalent Examination with at least 40% marks with science as one of the subjects.

Pedagogy:

The general pedagogy to be followed for theory and practicals are as under.

1. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counselling, Remedial Coaching.
2. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation, and Innovative methods.
3. Active learning as per LSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level 3.

Assessment:**Weightage for assessments (in percentage)**

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	30%	70%
Practical	30%	70%
Projects	30%	70%

Curriculum Structure for the Undergraduate Degree Program
B.Sc., (Hons) in Microbiology

Semester	Core Subjects (Credits) L T P	Discipline Specific/ Open Elective Subjects (Credits) L T P	Language L T P	Skill Enhancement Courses (SEC) / Ability Enhancement Compulsory Courses (AECC) L T P	Value Based / Activity Based Courses L T P	Total Credits
I	DSC 01 Fundamentals of Microbiology (5) 3+0+2 DSC 02 Microbial Diversity (5) 3+0+2	OEC 01 Microscopy (3) 3+0+0	L 1 (3) 3+0+0 L 2 (3) 3+0+0	SEC 01 Digital Fluency (3) 3+0+0	Value Based Course (VBC) 01 Health & Wellness (2) 2+0+0	24
II	DSC 03 Fundamentals of Cell Biology (5) 3+0+2 DSC 04 Basics of Biochemistry (5) 3+0+2	OEC 02 Microbial Techniques (3) 3+0+0	L 1 (3) 3+0+0 L 2 (3) 3+0+0	AECC 01 Environmental Studies (3) 3+0+0	Activity Based Course (ABC) 01 Instrumentation & Bioanalytical Techniques (2) 0+0+2 (Practice-Report & Viva)	24
Exit Option: Certificate with total 48 Credits						
III	DSC 05 Microbial Physiology (5) 3+0+2 DSC 06 Microbial Metabolism (5) 3+0+2	OEC 03 Microbiological Analysis of Air & Water (3) 3+0+0	L 1 (3) 3+0+0 L 2 (3) 3+0+0	AECC 02 Indian Constitution (2) 2+0+0 SEC 02 Artificial Intelligence (2) 2+0+0	-	23
IV	DSC 07 Microbial Genetics (5) 3+0+2 DSC 08 Recombinant DNA Technology (5) 3+0+2	OEC 04 Biofertilizers & Biopesticides (3) 3+0+0	L 1 (3) 3+0+0 L 2 (3) 3+0+0	SEC 03 Cyber Security (2) 2+0+0	Activity Based Course (ABC) 02 Clinical Microbiology (2) 0+0+2 (Practice – Report & Viva)	23
Exit Option: Diploma with total 94 Credits						

V	DSC 09 Environmental Microbiology (5) 3+0+2 DSC 10 Food & Dairy Microbiology (5) 3+0+2 DSC 11 Agricultural Microbiology (4) 3+0+1	DSE 01a. IPR, Biosafety & Bioethics (3) 3+0+0 OR DSE 01b. Bioremediation & Microbial Technology (3) 3+0+0	-	SEC 04 Basics of Bioinformatics (3) 3+0+0	Value Based Course (VBC) 02 Ethics & Self Awareness (2) 2+0+0	22
VI	DSC 12 Medical Microbiology (5) 3+0+2 DSC 13 Principles of Immunology (5) 3+0+2 DSC 14 Industrial Microbiology (4) 3+0+1	DSE 02a. Microbial Biotechnology (3) 3+0+0 OR DSE 02b. Antimicrobial Resistance (3) 3+0+0	-	SEC 05 – Professional / Societal Communication (3) 3+0+0	-	20
Exit option: Bachelor of Science, B.Sc., with total of 136 Credits						

VII	DSC 15 Virology & Parasitology (5) 3+0+2 DSC 16 Bacteria & Archaea (5) 3+0+2 DSC 17 Mycology & Phycology (5) 3+0+2	DSE 03a. Principles of Statistics (3) 3+0+0 & DSE 03b. Research Methodology (3) 3+0+0	-	-	-	21
VIII	DSC 18 Microbial Enzymology & Physiology (5) 3+0+2 DSC 19 Soil Microbiology & Plant Health (5) 3+0+2	DSE 04a. Microbial Nanotechnology (3) 3+0+0 (OR) DSE 04b. Industrial Training & Entrepreneurship (3) 3+0+0 AND 05a. Research Project (6) (OR) Choose any two of the following DSE 05b. Extremophilic Microbiology (3) 3+0+0 OR DSE 05c. System & Synthetic Microbiology (3) 3 +0+0 OR DSE 05d. Microbiome & Health (3) 3+0+0 OR DSE 05e. Vaccine Technology (3) 3+0+0				19
Award of Bachelor of Honors, B.Sc., (Hons) with total of 176 Credits						

Curriculum Structure for the Undergraduate Degree Program
B.Sc., (Hons) in Microbiology

SEMESTER I								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credits
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 01	Fundamentals of Microbiology	3	3	30	70	100	3
2	Practical 01	Fundamentals of Microbiology	4	3	15	35	50	2
3	DSC 02	Microbial Diversity	3	3	30	70	100	3
4	Practical 02	Microbial Diversity	4	3	15	35	50	2
5	OEC 01	Microscopy	3	3	30	70	100	3
6	Language 1	Part-I English I	3	3	30	70	100	3
7	Language 2	Part II English I/Kannada I/French I	3	3	30	70	100	3
8	SEC 01	Digital Fluency	3	3	30	70	100	3
9	VBC 01	Health & Wellness	2	2	-	50	50	2
Total Marks and Credits							750	24
SEMESTER II								
1	DSC 03	Fundamentals of Cell Biology	3	3	30	70	100	3
2	Practical 03	Fundamentals of Cell Biology	4	3	15	35	50	2
3	DSC 04	Basics of Biochemistry	3	3	30	70	100	3
4	Practical 04	Basics of Biochemistry	4	3	15	35	50	2
5	OEC 02	Microbial Techniques	3	3	30	70	100	3
6	Language 1	Part I English II	3	3	30	70	100	3
7	Language 2	Part II English II/Kannada II/French II	3	3	30	70	100	3
8	AECC 01	Environmental Studies	3	3	30	70	100	3
9	Activity Based Course 01	Instrumentation & Bioanalytical Techniques (2) 0+0+2 (Practice-Report & Viva) (Practical Based)	2	2	-	50	50	2
Total Marks and Credits							750	24

SEMESTER III								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 05	Microbial Physiology	3	3	30	70	100	3
2	Practical 05	Microbial Physiology	4	3	15	35	50	2
3	DSC 06	Microbial Metabolism	3	3	30	70	100	3
4	Practical 06	Microbial Metabolism	4	3	15	35	50	2
5	OEC 03	Microbiological analysis of air and Water	3	3	30	70	100	3
6	Language 1	Part-I English III	3	3	30	70	100	3
7	Language 2	Part II English III/Kannada III/French III	3	3	30	70	100	3
8	AECC 02	Indian Constitution	2	2	-	50	50	2
9	SEC 02	Artificial Intelligence	2	2	-	50	50	2
	Total Marks and Credits						700	23
SEMESTER IV								
1	DSC 07	Microbial Genetics	3	3	30	70	100	3
2	Practical 07	Microbial Genetics	4	3	15	35	50	2
3	DSC 08	Recombinant DNA Technology	3	3	30	70	100	3
4	Practical 08	Recombinant DNA Technology	4	3	15	35	50	2
5	OEC 04	Biofertilizer and Biopesticides	3	3	30	70	100	3
6	Language 1	Part-I English IV	3	3	30	70	100	3
7	Language 2	Part II English IV/Kannada IV/French IV	3	3	30	70	100	3
8	SEC 03	Cyber Security	2	2	-	50	50	2
9	Activity Based Course 02	Clinical Microbiology Hospital/Pathology Laboratory Visit (Report+ Viva Voce)	2	2	-	50	50	2
	Total Marks and Credits						700	23

SEMESTER V								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 09	Environmental Microbiology	3	3	30	70	100	3
2	Practical 09	Environmental Microbiology	4	4	15	35	50	2
3	DSC 10	Food and Dairy Microbiology	3	3	30	70	100	3
4	Practical 10	Food and Dairy Microbiology	4	4	15	35	50	2
	DSC 11	Agricultural Microbiology	3	3	30	70	100	3
6	Practical 11	Agricultural Microbiology	2	2	15	35	50	1
7	DSE 01a (OR) DSE 01b	IPR, Biosafety & Bioethics (OR) Bioremediation & Microbial Technology	3	3	30	70	100	3
8	SEC 04	Basics of Bioinformatics	3	3	30	70	100	3
9	V BC 02	Ethics & Self Awareness	2	2	-	50	50	2
	Total Marks and Credits						700	22
SEMESTER VI								
1	DSC 12	Medical Microbiology	3	3	30	70	100	3
2	Practical 12	Medical Microbiology	4	3	15	35	50	2
3	DSC 13	Principles of Immunology	3	3	30	70	100	3
4	Practical 13	Principles of Immunology	4	3	15	35	50	2
5	DSC 14	Industrial Microbiology	3	3	30	70	100	3
6	Practical 14	Industrial Microbiology	2	2	15	35	50	1
7	DSE 02a (OR) DSE 02b	Microbial Biotechnology (OR) Antimicrobial Resistance	3	3	30	70	100	3
8	SEC 05	Professional / Societal Communication	3	3	30	70	100	3
	Total Marks and Credits						650	20

SEMESTER VII								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 15	Virology & Parasitology	3	3	30	70	100	3
2	Practical 15	Virology & Parasitology	4	4	15	35	50	2
3	DSC 16	Bacteria & Archaea	3	3	30	70	100	3
4	Practical 16	Bacteria & Archaea	4	4	15	35	50	2
5	DSC 17	Mycology & Phycology	3	3	30	70	100	3
6	Practical 17	Mycology & Phycology	4	4	15	35	50	2
7	DSE 03a	Principles of Statistics	3	3	30	70	100	3
8	DSE 03b	Research Methodology	3	3	30	70	100	3
	Total Marks and Credits						650	22
SEMESTER VIII								
1	DSC 18	Microbial Enzymology & Physiology	3	3	30	70	100	3
2	Practical 18	Microbial Enzymology & Physiology	4	3	15	35	50	2
3	DSC 19	Soil Microbiology & Plant Health	3	3	30	70	100	3
4	Practical 19	Soil Microbiology & Plant Health	4	3	15	35	50	2
5	DSE 04a (OR) DSE 04b	Microbial Nanotechnology (OR) Industrial Training & Entrepreneurship	3	3	30	70	100	3
6	DSE 05a (OR) DSE05b DSE05c DSE 05d DSE 05e	5a Research Project (OR) CHOOSE ANY TWO OF THE FOLLOWING 5b Extremophilic Microbiology 5c System & Synthetic Microbiology 5d Microbiome & Health 5e Vaccine Technology	6	6	60	140	200	6
	Total Marks and Credits						600	19

Abbreviations: DSC – Discipline Specific Core; DSE – Discipline Specific Elective; AECC – Ability Enhancement Compulsory Course; SEC – Skill Enhancement Course

Students may choose any one elective course among the choice offered, specific to the discipline

*Project Proposal, Presentations, Team Work and Professional Ethics, Industrial/Institutional Visits etc.

Semester One

DSC 01 - FUNDAMENTALS OF MICROBIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The Course

- Is designed to get acquainted with the fundamental concepts of history of microbiology and provides the basic knowledge of microscopy and staining techniques
- Equips the students with basic microbiological techniques and operative skills in laboratory.

Course Outcome: At the end of the course, learners will be able to:

1. **Explain** the contributions made by prominent scientists in the field of microbiology.
2. **Demonstrate** the applications of various microscopes in observing microorganisms and can **implement** the knowledge of staining techniques.
3. **Describe** and **demonstrate** methods of sterilization and the use of chemical disinfectants as antimicrobial agents
4. **Explain** the preparation of media and **demonstrate** the methods of pure culture techniques, estimation of microbes and pure culture maintenance.

THEORY

UNIT-I HISTORY OF MICROBIOLOGY

- a) History of Microbiology; Theory of biogenesis and abiogenesis.
- b) Contributions of following scientists to the field of Microbiology: Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff.

UNIT-II MICROSCOPY AND STAINING TECHNIQUES

- a) Microscopy: Principles and applications of Brightfield, Dark field, Phase contrast, Fluorescence; Electron Microscopy: SEM & TEM. Specimen preparation for electron microscopy.
- b) Stains and staining techniques: Basic, acidic, and neutral stains. Specimen preparation for staining; Types of staining techniques –Simple (Positive and negative), Differential staining (Gram's, Endospore, Acid-fast), Structural staining (Capsule, Nuclear and Flagellar).

UNIT-III STERILIZATION AND DISINFECTION

- a) Physical methods- Dry heat (Hot Air Oven, Incineration), Moist heat (Autoclave, Tyndallization), Filtration (Membrane filters and HEPA filter), Radiation (UV radiation).
- b) Chemical methods - Definition of terms-disinfectants, antiseptics, sanitizers, microbicides, microbistatic. Use and mode of action: alcohols, aldehydes, halogens, phenols, peroxides, heavy metals, detergents, and quaternary ammonium compounds.

UNIT-IV CULTURE TECHNIQUES AND PRESERVATION OF MICROBES

- a) Culture techniques: Types of Media – Solid, liquid, Natural, Synthetic, Semi Synthetic, Enriched, Enrichment, Selective, Differential and Special purpose media (one example for each type); Anaerobic culture techniques –Wright's tube, Roll tube, McIntosh & Fildes's jar method. Pure culture techniques–Tube dilution, pour plate, spread plate, Streak plate and Micromanipulator.
- b) Maintenance and Preservation techniques: short term preservation – Slant, Stab, Mineral oil overlay; Long term preservation–Lyophilization, Cryopreservation, Storage in sterile soil, Storage in silica gel.

PRACTICAL 01: FUNDAMENTALS OF MICROBIOLOGY

1. Laboratory safety: General rules and Regulations; General behavior in microbiology Lab. Study of Simple and Compound Microscopes.
2. Use and mode of action: Soaps, Detergents, Phenol, Ethyl alcohol, Iodine, Sodium Hypochlorite and Preparations of stains and mordant (Methylene Blue, Crystal Violet, Safranin, Nigrosine, Malachite Green, Carbol fuchsin, Gram's Iodine, Lactophenol Cotton Blue).
3. Staining Techniques: Simple Staining- Positive and Negative, Differential Staining- Gram's Staining, Structural Staining- Endospore Staining.
4. Micrometry: Measurements of Microorganisms using stage and ocular micrometer.
5. Preparation of Media and: Nutrient agar, Potato Dextrose agar, Czapeck Dox agar, MacConkey's agar, EMB agar.
6. Pure culture techniques: Point inoculation, Streak plate, Pour plate, Spread plate, Serial Dilution.
7. Maintenance and preservation of cultures: Agar slants and stab culture; Overlaying with Mineral oil.
8. Demonstration of Laboratory Equipment's: Autoclave, Pressure Cooker, Hot Air Oven, Incubator, Laminar Airflow System, Membrane Filter, Inoculation Loop and Needle, Colony Counter. Study of microscopes and contributions of microbiologists (mentioned in theory syllabus).

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1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
2. Cappuccino. J. and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.
3. Dubey, R. C. and Maheshwari, D.K. (2013). Text book of Microbiology, S Chand and company limited, Ramnagar, New Delhi.
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5. Pelczar, M. J., Chan, E. C. S. and Moel (2001). Microbiology, McGraw Hill Book Company, New York.
6. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
7. Prescott, Harley and Klein. (2014). Microbiology, 9th edition, McGraw Hill Publishers.

DSC 02 - MICROBIAL DIVERSITY

L	T	P	C
3	0	2	5

Course Objectives: The Course

- Will provide knowledge on diversity of microorganisms, characteristics, classification.
- Emphasizes the interactions within the microbial communities, plants, and animals

Course Outcomes: At the end of the course, learners will be able to:

1. **Describe** the basis for classification of microorganisms, and cellular organization in prokaryotes and eukaryotes.
2. **Explain** the types and morphological details of different viruses.
3. **Describe** and **demonstrate** the morphology, ultrastructure, reproduction, and economic importance of bacteria.
4. **Discuss** the life cycle and importance of algae, fungi and protozoa and **demonstrate** their morphological structures.

THEORY

UNIT-I MICROBIAL WORLD

- a) Groups of microorganisms: Prokaryotes (Cyanobacteria and Bacteria), Eukaryotes (Algae, Fungi, Protozoa).
- b) Study of ultrastructure of prokaryotic and eukaryotic cell- A comparative account.
- c) Microbial taxonomy: General principles and nomenclature; Types of classification- Ernst Haeckel's Three Kingdom classification, Robert H. Whittaker's Five Kingdom classification and Carl R. Woese Three Domain System of classification.

UNIT-II VIRUSES

- a) General characteristics of viruses (Definition, size, shape, chemical composition and properties) and importance.
- b) Study of the following viruses:
Structure and replication of Bacteriophages (T₄ phage), Phytophagenae (TMV), Zoophagenae (Rabies virus and HIV), Cyanophages (Structure of LPP-1), Mycophages (Types and examples of mycoviruses).
- c) A brief account on viroids and prions.

UNIT- III BACTERIA

- a) Occurrence, shape, arrangement and division of bacterial cells.
- b) Ultrastructure of Eubacterial cell- Cell wall (Gram positive and Gram negative), Capsule, Cell membrane, Mesosome, Cytoplasm, Ribosome, Nucleoid, Plasmids, Flagella, Pili, Fimbriae, Inclusion bodies, Endospore.
- c) Study of archaebacteria in brief.
- d) Classification in brief as per Bergey's Manual of Systematic Bacteriology.
- e) Structure, reproduction, and economic importance of following:
 - 1) Bacteria: Chlamydiae, Mycoplasma, Actinomycetes, Rickettsia and Spirochetes.
 - 2) Cyanobacteria: *Nostoc*, *Microcystis* and *Spirulina*.

UNIT-IV ALGAE, FUNGI & PROTOZOA

- a) Algae: Occurrence, Fritch's classification and general characteristics of algae. Study of thallus structure, reproduction (in brief) and economic importance of the following algae: *Chlorella*, *Cosmarium*, *Spirogyra*, *Diatoms* and *Gracilaria*.
- b) Fungi: Occurrence, Nutrition, Classification (Alexopolus and Mims) and General characteristics of fungi. Thallus structure, reproduction and life cycle, economic importance of the following fungi: *Pythium*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Saccharomyces*, *Agaricus* and *Fusarium*.
- c) Protozoa: Occurrence, Nutrition and Classification. Structure, Mode of nutrition and reproduction of the following: *Paramecium*, *Euglena* and *Entamoeba*.

PRACTICAL 02: MICROBIAL DIVERSITY

1. Staining and mounting of algae and fungi
2. Studying of motility of bacteria by hanging drop method.
3. Study of Cyanobacteria: *Nostoc*, *Spirulina* and *Microcystis*.
4. Study of Algae: *Chlorella*, *Cosmarium*, *Diatoms*, *Spirogyra* and *Gracilaria*
5. Study of Fungi: *Pythium*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Saccharomyces*, *Agaricus* and *Fusarium*.
6. Study of Protozoa: *Entamoeba*, *Euglena* and *Paramecium*.
7. Study of the following using photographs or slides: *Lactobacillus*, *E. coli*, Bacteriophages, TMV, FMD Virus, Rabies Virus, Actinomycetes, Spirochetes, Chlamydiae, and Mycoplasma.

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1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
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OEC 01 - MICROSCOPY

L	T	P	C
3	0	0	3

Course Objectives: The course

- Is designed to provide students from various fields a comprehensive and practical use of microscopy techniques.
- Is oriented towards teaching the principles of basic & modern microscopy techniques.

Courses Outcomes: At the end of the course, learners will be able to:

1. **Demonstrate** the handling and maintenance of microscopes.
2. **Explain** the working principle and procedure of different types of microscopes.
3. **Discuss** the construction and types of electron microscope along with limitations.
4. **Describe** the specimen preparation and staining procedures.

THEORY

UNIT-I FUNDAMENTALS OF MICROSCOPY

- a) History of Microscopy
- b) Parts of a microscope, Types of microscopes (simple and compound), Numerical aperture, Magnification, Resolving power, Oil immersion objective, Working principle and procedure, handling and maintenance of microscope.
- c) Measurement of microorganisms-Micrometry.

UNIT-II LIGHT MICROSCOPY

Study of working principle, procedure, and applications of

- a) Bright field microscope
- b) Dark field microscope
- c) Phase contrast microscope
- d) Fluorescence and Confocal microscope.

UNIT-III ELECTRON MICROSCOPY

Study of working principle, procedure, and applications of Electron Microscopy

- a) Transmission Electron Microscope
- b) Scanning Electron Microscope
- c) Limitations of Electron Microscope

UNIT- IV SPECIMEN PREPARATION

- a) Light Microscopy: Simple staining (Positive and Negative), Differential staining (Gram's), Wet mounting technique.

- b) Electron Microscopy: Specimen Processing-dehydration, Fixation, Embedding, Sectioning & Ultra-Thin-Sectioning, Staining, Shadowing, Freeze fracturing and etching, Sputter Coating, Surface replica. Applications of Microtome in sample preparation.

REFERENCES

1. Murphy DB and Davidson MW. (2013). Fundamentals of Light Microscopy and Electronic Imaging. 2nd edition. Wiley Blackwell.
2. Williams DB and Carter BC. (2009). Transmission Electron Microscopy: A Textbook for Materials Science .2nd edition. Springer.
3. Yuste R. (2010). Imaging: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
4. Egerton RF. (2005). Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM. Springer.
5. Bell CD and Erdman N. (2013). Low Voltage Electron Microscopy: Principles and Applications. John Wiley and Sons, Ltd.

Language – Part I English I

L	T	P	C
3	0	0	3

Course Objectives:

- Improve and enhance the communication skills of the learners.
- Improve speech pronunciation, grammar and vocabulary.

Course Outcomes:

After successful completion of the course, students will be able to

1. Have better language, communication and pronunciation skills.
2. Have enhanced their vocabulary since they would have learned about root words, synonyms, antonyms, phobias and manias.
3. Use the Language Lab by Senako Software to improve their vocabulary. The Language Lab is equipped with exercises for language learning. The Voice Pronounce guides the students to improve their pronunciation through instant feedback and visual indication of what sounds and words to improve on.

Unit-I: Grammar – I

1. Correct Use of Nouns
2. Correct Use of Pronouns
3. Reading Comprehension Passage

Unit-II: Grammar – II

1. The rules and sequence of tenses
2. Types of sentences: Simple, Compound and Complex sentences, clauses, phrases, adjuncts and gerunds
3. Subject Verb Agreement

Unit-III: Vocabulary

1. Roots A to F
2. Synonyms and Antonyms
3. Phobias and Manias

Unit-IV: Essay

Excerpts from APJ Abdul Kalam's "Wings of Fire "

References

1. S.C Gupta, 2021, English Grammar and Composition, Arihant Publishers
2. S. P. Bakshi, 2021, Objective General English, Arihant Publishers

Language – Part II English I

Course Objectives:

- Improve and enhance the literary skills of the learners.
- Develops language skills such as reading, writing, speaking and listening.
- Help the students to grasp the ideas of the writer.

L	T	P	C
3	0	0	3

Course Outcomes:

After successful completion of the course, students will be able to

1. Express their thoughts, ideas, feelings, and observations.
2. Develop philosophical, historical and critical perspectives in their writings.

Unit-I: British Poetry

1. "When in Disgrace" by Shakespeare
2. "Spring" by Christina Rossetti

Unit-II: Post Colonial Literature

1. "The Night of the Scorpion" by Nissim Ezekiel
2. "I Am Not That Woman" by Kishwar Naheed

Unit-III: Contemporary and British Literature

1. "The Kanda Man-eater" by Jim Corbett
2. "A Man Who Had No Eyes" by MacKinlay Kantor
3. "A Child's Story" by Charles Dickens

Unit-IV: Indian English Literature

"The Education System in India" by Dr. V. Shashi Kumar

References:

1. Jim Corbett, 1944. The Man-Eaters of Kumaon, Oxford University Press.
2. Charles Dickens, 2013. Children's Stories, Bottom of The Hill Publishing.

Language – Part II Kannada I

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 1

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

➤ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಮೂಡಿಸುವುದು

- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಕಲ್ಪಿಸುವುದು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ಬೆಳಕು ಚೆಲ್ಲುವುದು
- ಭೂಮಿ ಕುರಿತ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಬೆಳೆಸಿಕೊಳ್ಳುವರು
- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಪಡೆದುಕೊಳ್ಳುವರು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಭೂಮಿಯ ಬಗೆಗಿನ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು

ಘಟಕ – 1, ನಾಡು-ನುಡಿ-ಚಿಂತನೆ

- 1) ನಾಡು, ನುಡಿ, ಸಂಸ್ಕೃತಿ : ಶ್ರೀ ವಿಜಯನ ಕವಿರಾಜಮಾರ್ಗ
- 2) ಕಾಣಿಕೆ : ಬಿ.ಎಂ.ಶ್ರೀಕಂಠಯ್ಯ
- 3) ರತ್ನನ ಪದಗೊಳ್ : ಜಿ.ಪಿ.ರಾಜರತ್ನಂ
- 4) ಕಟ್ಟುವೆವು ನಾವು : ಎಂ ಗೋಪಾಲ ಕೃಷ್ಣ ಅಡಿಗ

ಘಟಕ – 2, ಭೂಮಿ

- 1) ಬೆಳಗಾಗಿ ನಾನೆದ್ದು ಯಾರ್ಯಾರ ನೆನೆಯಾಲಿ : ಜನಪದ
- 2) ಭೂಮಿ ತಾಯಿಯ ಚೊಚ್ಚಲ ಮಗ : ದ.ರಾ. ಬೇಂದ್ರೆ
- 3) ಕುಂಕುಮ ಭೂಮಿ : ಕೆ.ಎಸ್ ನರಸಿಂಹಸ್ವಾಮಿ
- 4) ಅವ್ವ : ಪಿ. ಲಂಕೇಶ

ಘಟಕ – 3, ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ

- 1) ಧನ್ವಂತರಿ ಚಿಕಿತ್ಸೆ : ಕುವೆಂಪು
- 2) ವಂಡೂರಿನ ಹವಳದ ದಂಡೆಗಳು : ಕೆ.ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
- 3) ನಿಸರ್ಗದ ನಿಗೂಢ ಕುರಿಂಜಿಲೋಕ : ನಾಗೇಶ ಹೆಗಡೆ

ಘಟಕ – 4, ಭಾಷಾ ಭಾಗ

- 1) ಪತ್ರ ವ್ಯವಹಾರ, ಸಾಮಾನ್ಯ ಪತ್ರ, ಮನವಿ ಪತ್ರ
- 2) ಆಡಳಿತ ಕನ್ನಡ ಬೆಳೆದು ಬಂದ ದಾರಿ
- 3) ಆಡಳಿತ ಭಾಷೆಯ ಸ್ವರೂಪ ಮತ್ತು ಲಕ್ಷಣ

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- 1) ಕವಿರಾಜ ಮಾರ್ಗ- ಶ್ರೀ ವಿಜಯ,
- 2) ಕುವೆಂಪು ಕೃತಿ ವಿಮರ್ಶೆ- ಪ್ರೊ.ಅರವಿಂದ ಮಾಲಗತ್ತಿ
- 3) ಆಡಳಿತ ಕನ್ನಡ – ಎಚ್‌ಎಸ್‌ಕೆ

L	T	P	C
3	0	0	3

Language – Part II French I

Course Objectives

- The course aims at making the learner understand and use familiar day-to-day expressions and very basic phrases in French.
- The learners are taught to introduce themselves and others, ask and answer questions about personal details in French.

Course Outcomes:

After successful completion of the course, students will be able to

1. Improve the listening and speaking skills by listening to audio lessons.
2. Read, comprehend, and analyze a wide range of texts such as small paragraphs and comprehension in French.

Unit 1

1. Greet people
2. Talk about yourself

Unit 2

1. Talk about where you live

Unit 3

1. Talk about your family members

Unit 4

1. Talk about your likes and dislikes

References:

1. Stahl Christian, 2018. 100 French Short Stories for Beginners Learn French with Stories Including Audiobook published by Lulu.com.
2. [S. Singh Kajal Chawla](#) Toujours Francais:- French Volume -0, language Learning Books for beginners, Easy French Step-by-Step Learning method:-Educational book published by Souvenir Publishers Pvt. Ltd.

Skill Enhancement Course (SEC 01) – Digital Fluency

L	T	P	C
3	0	0	0

Course Objectives:

- To introduce students to the realm of technology.
- To impart knowledge regarding the benefits of digitization.
- To help students gain digital literacy.

Course Outcomes:

After successful completion of the course, students will be able to

1. Have an intelligent conversation on the key concepts and applications of Artificial Intelligence, Big Data Analytics, Internet of Things, Cloud Computing and Cybersecurity.
2. Develop holistically by learning essential skills such as problem-solving, design thinking and teamwork.

Theory

Unit-I: Emerging Technologies – Overview of emerging Technologies – Artificial Intelligence (AI), Machine Learning, Deep Learning. Database Management for Data Science, Big Data Analytics. Internet of Things (IoT) and Industrial Internet of Things (IIoT). Cloud computing and its service models. Introduction to Cyber Security and Types of cyber-attack.

Unit-II: Applications of Emerging Technologies – Artificial Intelligence (AI), Big Data Analytics, Internet of Things, Cloud Computing, Cyber Security.

UNIT III: Essential skills beyond Technology: Safe usage of the internet, Creative Problem solving & Critical Thinking, Innovation and Design Thinking, Use of tools in enhancing skills.

References

1. Mehrotra D., 2019. Basics of artificial intelligence & machine learning, Notion Press.
2. Zsolt N., 2018. Artificial Intelligence & Machine Learning Fundamentals, Packt Publishers.

L	T	P	C
2	0	0	2

Course Objectives:

- To introduce the concept of health, food, nutrition and diet and their role in malnutrition, communicable and non-communicable diseases.
- Relationship between of yoga and Ayurveda.
- The psychology, various emotions and behavioral aspects.

Course Outcomes:

At the end of the course, students would be able to understand the

- Need of food, nutrition, diet and causes of malnutrition and various disease conditions.
- Gains knowledge of yoga and Ayurveda their health benefits.
- Psychology, various personalities and their effect on concentration.

Unit I

Definition of health, food, nutrients, nutrition, diet, RDA (ICMR & WHO), Balanced Diet, malnutrition. Exercise & fitness. Incidence of Nutritional problems, signs, symptoms and treatment- Protein Energy Malnutrition, Micro Nutrient deficiencies (Vit-A, Iron, Iodine and Zinc)- Causes & consequences of malnutrition. Intervention programs: Mid-Day Meal Programme, NIPPCD Fortification and enrichment of foods, NIN, ICMR, WHO, FAO.

Unit - II

Communicable Diseases causes and prevention -cholera, polio, measles, HIV. Impact of NCDs on public health. Non-communicable diseases causes and prevention: Obesity, Diabetes mellitus, hypertension, CVD, Cancer, Osteoporosis

Unit - III

Yoga and health science- Introduction to Yoga; Objective of Yoga; Concept of Mind according to Yoga; Importance of Yoga & Misconceptions of Yoga. Ayurveda- Principles; Dosha theory. Interrelation between Yoga and Ayurveda. Herbal remedies and Nutraceuticals.

Unit - IV

Psychology, emotion, personality, motivation, cognition, cognitive learning, memory, forgetting and Artificial Intelligence - definitions and types. Understanding basic behavioral aspects- attention and concentration.

References

1. Vinodini Reddy., Pralhad Raj, Gowrinath Sastry J, Kashinath, K.C. (1993), Nutrition Trends in India, NIN, Hyderabad.
2. Park and park (1995), Text book of preventive and social medicine, Banarsidas published by Jabalpu.
3. Jellifee, D.D and Pathes (1989), Assessment of Nutritional status of community, WHO, Geneva.
4. Baron RA and Misra G, (2014), Psychology, Fifth Edition, New Delhi, By Pearson education.
5. Yoga Health by Dr H R Nagendra & Dr R Nagarathna.

Semester Two

DSC 03 - FUNDAMENTALS OF CELL BIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Describes the intricate relationship between various cellular structures and their corresponding functions.
- Provides the knowledge on how cells co-operate and communicate with each other.

Course Outcomes: At the end of the course, learners will be able to:

1. **Describe** the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2. **Compare** the processes by which newly synthesized proteins are targeted to different cellular locations
3. **Conceptualize** cell growth, division, survival, death and regulatory mechanisms.
4. **Understand** the functioning and impairments of cell organelles and the regulation of cellular processes can lead to disease.

THEORY

UNIT-I CELL ORGANIZATION

- a) Prokaryotic (Bacteria) and eukaryotic (Plant cell and animal cell)
- b) Plasma membrane: Structure and transport of small molecules (Passive and Active transport)
- c) Extra cellular matrix and cell matrix interactions, Cell-cell interactions – adhesion junctions, tight junctions, gap junctions, and plasmodesmata (structural concepts)

UNIT-II CYTOSKELETON AND NUCLEUS

- a) Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.
- b) Nucleus: Nuclear envelope, nuclear pore complex and nuclear lamina. Chromatin, Nucleolus, Structure of DNA (Prokaryotic and eukaryotic).

UNIT – III CHROMOSOMES

- a) Types of chromosomes based on centromere, karyotype and idiogram; Special types of chromosomes – salivary gland, lampbrush and B chromosome.
- b) Fine structure, DuPraw model, Nucleosome model, Chemical organization of nucleosome – nucleoproteins, Chromatin: Euchromatin and Heterochromatin and packaging.

UNIT – IV CELL CYCLE, CELL DEATH AND RENEWAL

- a) Cell division and cell cycle: Mitosis and meiosis, Cell cycle regulation, steps and control of cell cycle, Programmed cell death.
- b) Mutations: Mutagens – physical and chemical mutagens, types of mutations. Cancer: Development and causes of cancer, oncogenes, tumor suppressor genes.

PRACTICAL 03: FUNDAMENTALS OF CELL BIOLOGY

1. Study of representative plant and animal cell by microscopy.
2. Preparation of temporary stained mount of human cheek cells.
3. Counting of cells by Haemocytometer.
4. Cytochemical staining of DNA – Feulgen.
5. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
6. Study of different stages of Mitosis & Meiosis – Onion root tip and inflorescence.
7. Study of the structure of cell organelles through electron micrographs.

REFERENCES

1. Becker, Kleinsmith, and Hardin. (2009). The World of the Cell, 8th Edition, Benjamin Cummings Publishing, San Francisco.
2. Bruce A, Bray D, Levis J, Raff M, Robert K and Watson J. (2008). Molecular Biology of the Cell, 5th Edition, Garland publishing Inc., New York and London.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2009). The Cell and Molecular Biology, 8th Edition, Lippincott Williams & Wilkins, Philadelphia.
5. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th Edition. Pearson.
6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments, 6th Edition, John Wiley & Sons Inc.

DSC 04 - BASICS OF BIOCHEMISTRY

L	T	P	C
3	0	2	5

Course Objectives: The Course

- Provides the knowledge about the structure and functions of biomolecules.
- Deals with the core principles and importance of biomolecules in life

Course Outcomes: At the end of the course, the learners will be able to

1. **Explain** the structure, types, and functions of carbohydrates.
2. **Conceptualize** the knowledge of protein classification and its functions.
3. **Describe** major classes of lipids and its role in cell signaling.
4. **Elucidate** structures of different nucleic acids and **explain** types and functions of vitamins.

THEORY

UNIT- I CARBOHYDRATES

- a) General functions of carbohydrates, Families of monosaccharides – aldoses and ketoses. Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose. sugar derivatives, glucosamine.
- b) Disaccharides; glycosidic linkages; Reducing and non-reducing sugars, occurrence and Haworth projections of sugars, storage polysaccharides, Structural polysaccharides, bacterial cell wall polysaccharides

UNIT -II PROTEINS

- a) Biological functions of proteins; Amino acids - classification, peptide bond, peptides, polypeptides.
- b) Protein: Primary, secondary, tertiary, and quaternary structures Proteins as enzymes, hormones and receptors, protein folding and denaturation – factors affecting it, structural, membrane and secretory proteins.

UNIT- III LIPIDS

- a) Biological functions of lipids; Major classes of lipids – simple, complex, and derived; Fatty acids - structure and functions. Saturated and unsaturated fatty acids; Storage lipids- Structure, functions, and properties of Triacylglycerols.
- b) Structural lipids: Structure, functions, and properties of Phosphoglycerides, Sphingolipids, Glycosphingolipids; Lipoproteins.
- c) Lipids in cell signalling, as cofactors, Eicosanoids; lipid micelles - monolayers, and bilayers (fluid mosaic model)

UNIT -IV NUCLEIC ACIDS AND VITAMINS

- a) Pentose sugars – ribose and deoxyribose; purines, pyrimidines, nucleosides, nucleotides, phosphodiester bond, base pairing, Chargaff's rule; Structure, types, and functions of DNA and RNA; Models - Watson and Crick model of DNA, Clover leaf model of t-RNA
- b) Supercoiling of DNA, nucleosomes, denaturation and renaturation of DNA, T_m and C₀t curve, DNA-protein interactions.
- c) Vitamins: types – water and fat soluble and their biological functions.

PRACTICAL 04: BASICS OF BIOCHEMISTRY

1. Calculation of Normality, Molarity and Molality; Preparation of buffers and pH adjustment
2. Tests for presence/absence of carbohydrates (Molisch's test, Iodine test, Benedicts test, Barfoed's test, Fehling's test).
3. Estimation of reducing sugar by Dinitrosalicylic acid method.
4. Tests for identification of proteins (Biuret test, Ninhydrin test)
5. Protein estimation by Lowry's/Bradford's method.
6. Study of protein secondary and tertiary structures with the help of models.

REFERENCES

1. Tortora, G.J., Funke, B.R and Case, C.L. (2004). Microbiology: An Introduction. Pearson Education, Singapore.
2. Wilson, K and Walker, J. (2000). Practical Biochemistry (Principles in Techniques), 5th edition, Cambridge University Press, UK.
3. Devlin, J. M. (2011). Text book of Biochemistry with clinical correlations, 7th edition, John wiley and sons, Inc. USA.
4. Voet, D.J., Voet, J.G. and Pratt, C.W. (2008). Principles of Biochemistry, 3rd edition, John wiley and sons.
5. Elliott, W.H and Elliott, D.C. (2009). Biochemistry and molecular biology, 4th edition, Oxford university press, New york.

OEC 02 - MICROBIAL TECHNIQUES

L	T	P	C
3	0	0	3

Course Objectives: The course

- Gives the basic information on the principles of sterilization, types of media, their applications, and techniques for isolation of pure cultures
- Imparts the skills required for routine culture and preservation of microorganisms.

Course Outcomes: At the end of the course, the learners will be able to

1. **Demonstrate** the various sterilization techniques and their applications
2. **Understand** the different types of microbial culture and culture media.
3. **Execute** the culture techniques for isolation, growth and preservation of microorganisms.
4. **Measure** and **interpret** the growth of microorganisms using various methods.

THEORY

UNIT-I STERILIZATION TECHNIQUES

- a) Sterilization: Definition & Types. Physical methods: Dry heat- Hot air Oven, Incineration, Tyndallization; Moist Heat- Autoclave, Pressure Cooker; Radiations: Ionizing and Non-ionizing radiations.
- b) Chemical methods: Alcohol, Aldehydes, Phenols, Halogens, and Ethylene Oxide.
- c) Filtration: Depth Filters, HEPA filters and Membrane filters.

UNIT-II CULTURE MEDIA

- a) Definition, Types of culture: Pure, Axenic, and Mixed
- b) Types of culture media: Natural, Synthetic, Semi-synthetic, Differential, Indicator, Selective, Enriched, Minimal, Maintenance and Transport Media.
- c) Preparation of culture media: Liquid media (broth), Solid media (Agar), Buffers

UNIT-III CULTURE TECHNIQUES & PRESERVATION

- a) Isolation Techniques: Pour, Spread and Streak (Zigzag, Parallel, and Quadrant), Serial dilution.
- b) Cultivation – aerobic and anaerobic bacteria, fungi.
- c) Maintenance and preservation of pure cultures: Sub-culturing, Agar slant, Stab method, overlay with mineral oil, paraffin method, glycerol stock, freeze drying. Culture collection centers.

UNIT-IV MICROBIAL GROWTH

- a) Measurement of cell size - Micrometry, Measurement of cell number – Haemocytometer and Colorimeter/Spectrophotometer.
- b) Growth curve –phases, generation time; Batch, Continuous and Diauxic culture.

REFERENCES

1. Bisen P.S., Varma K. : Handbook of Microbiology CBS Publishers and Distributors, Delhi.
2. Dubey R.C. and D.K. Maheshwary, A textbook of Microbiology S chand and Co. New
3. Delhi.
4. Pelczar Michael J., Jr./E.C.S. Chan, Elements of Microbiology: McGraw, Hill International
5. Book Company, New Delhi.
6. Pelczar Michael J., Jr. E.C.S Chan, Noel R.Krieg : Microbiology : Concepts and applications-
McGraw Hill Inc.
7. Pelczar Michael J., Reid R.D. and Chan E.C.S.: Microbiology, Tata McGraw hill publishing
8. Co. Ltd., New Delhi.
9. Powar C.B.and Dagainawala H.F.: General microbiology Vol I and II Himalaya publishing
10. house Bombay.
11. Prescott L.M., Harley J.P., and Klein Donald A.: Microbiology, W.M.C., Brown publishers

Language – Part I English II

L	T	P	C
3	0	0	3

Course Objectives:

- Understand and apply the purpose of adjectives, adverbs and prepositions.
- Apply the rules of reported speech in dialogue writing.
- Bring life to the words and enhance creativity in writing by using figures of speech like alliteration, metaphor and simile.

Course Outcomes:

After successful completion of the course, students will be able to

1. Correct errors in sentences by applying rules of adjectives, adverbs and prepositions.
2. Reveal the tone and moods of the characters and improve writing of dialogues by applying the rules of Reported Speech.
3. Use figurative language to elicit emotion, help readers form mental images and draw readers into the work.

Unit-I: Grammar

1. Correct Use of Adjectives
2. Reported Speech
3. Correct Use of Adverbs
4. Correct Use of Prepositions
5. Formal Letters (**Resume and Cover letter**) and Writing Emails
6. Reading Comprehension Passage

Unit-II: Vocabulary – I

1. Roots: G to L
2. Figures of Speech: Alliteration, Metaphor, Simile

Unit-III: Vocabulary – II

1. Prefixes and Suffixes
2. New Words in English

Unit-IV: Essay: Indian English Literature

Swami Vivekananda's Address at Parliament of Religions in Chicago

References

1. Lewis Norman (2016) Word Power Made Easy, published by Goyal Publishers & Distributors Pvt. Ltd.
2. Raymond Murphy (2009) Grammar in Use Intermediate Student's Book with answers: Self-study Reference and Practice for Students of North American English, published by Books wagon.
3. Raymond Murphy (2013) English Grammar in Use: A Self Study Reference and Practice Book Intermediate Learners Book published by Cambridge University Press.

Language – Part II English II

L	T	P	C
3	0	0	3

Course Objectives:

- Learn and appreciate different kinds of literature like Indian English, British and American literature.
- Learn to appreciate the importance of moral and ethical values in life through study of literature.

Course Outcomes:

After successful completion of the course, students will be able to

1. Critically analyze the after effects of Industrial Revolution in Britain through the poem “The Chimney Sweepers” by William Blake
2. Know about the importance of nature. Nature is the best teacher which can teach humans about what is evil and what is good through the poem “The Tables Turned” by William Wordsworth.
3. Learn that every person must understand his/her own abilities and talents and not be fooled by a critic who may not have the best intentions through the poem “The Frog and the Nightingale” by Vikram Seth.

Unit-I: Poetry from the Romantic period

1. “The Chimney Sweepers” by William Blake
2. “The Tables Turned” by William Wordsworth

Unit-II: Indian English Poetry

1. “The Frog and the Nightingale” by Vikram Seth
2. “Battle with Death”, Translating Atal Bihari Vajpayee’s Hindi poem “Maut Se Thann Gayi”.

Unit-III: British and American Prose

1. “The Mammon and The Archer” by O’Henry
2. “The Tell-Tale Heart” by Edgar Allan Poe
3. “The Case for The Defence” by Graham Greene

Unit-IV: Drama Translation Works

“Yama’s Defeat” by Kuvempu translated from Kannada to English by Dr. C. Naganna

References:

1. Vajpayee Atal Bihari 21 poems by Atal Bihari Vajpayee, translated by Pavan K Verma published by Penguin Books India Pvt Ltd.
2. Henry O ‘ 100 Selected Stories published by Vasana Book Depot.
3. Edgar Allen Poe (2019) The Tell-Tale Heart published by Blurb.
4. Thomson Sharada’s Savitri published by Wordcatcher Publishing.

L	T	P	C
3	0	0	3

Language- Part II Kannada II

ಸಾಹಿತ್ಯ ಸಿಂಹನ -೨

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಬೆಳಕು ಬೆಲ್ಲುವುದು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ವಿಸ್ತಾರವಾದ ತಿಳುವಳಿಕೆ ಹೊಂದುವರು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯವನ್ನು ಗ್ರಹಿಸಿಕೊಳ್ಳುವರು.

ಘಟಕ - ೧, ಬೀವನ ಕಲೆ

೧) ಜಲಗಾರ : ಕುವೆಂಪು

ಘಟಕ - ೨, ಕನಕು

- ೧) ಅಕ್ಕ ಕೇಳವ್ವ ನಾನೊಂದು ಕನಕು ಕಂಡೆ : ಅಕ್ಕ ಮಹಾದೇವಿ
 ೨) ಕವದ ಮನೆ : ಚದುರಂಗ
 ೩) ರಂಗಣ್ಣನ ಕನಸಿನ ದಿನಗಳು (೮. ಭಾ) : ಎಂ.ಆರ್.ಪ್ರದೀಪಾಸಮೂರ್ತಿ

ಘಟಕ- ೩, ಮಲೆ

- ೧) ಮುಕ್ಕಣ್ಣ ಮಲೆ ಕರುಣಿಸೋ : ಜನಪದ ಕಾವ್ಯ
 ೨) ತಿಂಕಣಗಾಳಿಯಾಟ : ಪಂಜೆ ಮಂಗೇಶರಾಯರು
 ೩) ಅಮೆಜಾನ್ ಮಲೆಕಾಡಿಗೆ ಅಗ್ನಿ ಪರೀಕ್ಷೆ : ಟಿ. ಆರ್ ಅನಂತರಾಮು

ಘಟಕ -೪, ಭಾಷಾ ಭಾಗ

- ೧) ಗಾಡೆ, ಸ್ವರೂಪ ಲಕ್ಷಣ
 ೨) ಪ್ರಬಂಧ, ಸ್ವರೂಪ ಲಕ್ಷಣ
 ೩) ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರ, ಅಧಿಕೃತ, ಅರೆ ಅಧಿಕೃತ ಪತ್ರಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ :

- ಕುವೆಂಪು ಸಂಪದ - ಡಾ.ಪ್ರಧಾನ್ ಗುರುದತ್ತ
 ಕನ್ನಡದ ಅತ್ಯುತ್ತಮ ಸಣ್ಣ ಕತೆಗಳು - ನರಸಿಂಹ ಮೂರ್ತಿ
 ಆಡಳಿತ ಕನ್ನಡ - ಡಾ. ಮುರಿಗೆಪ್ಪ

L	T	P	C
3	0	0	3

Language – Part II French II

Course Objectives:

- The students are taught to interact in a simple way provided the other person talks slowly and clearly and is prepared to help.

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain an appreciation and understanding of the diversity of the Francophone world within the broader framework of multicultural communities and global perspectives.
2. Comprehend and respond with grammatical accuracy to spoken and written French as well as demonstrate cultural awareness.

Unit 1

1. Engage in a simple buy-and-sell situation

Unit 2

1. Ask about the day, the time and the date
2. Accept and refuse

Unit 3

1. Read simple notices, posters and catalogs

Unit 4

1. Fill in a simple form
2. Write a simple postcard

References:

1. [Verma Rashmi](#), 2020. French Made Easy published by Goodwill Publishing House.
2. Kendris Christopher, 2011. Barron'S Foreign Language Guides - 501 French Verbs (with CD) published by Goyal Publishers & Distributors Pvt. Ltd.

Ability Enhancement Compulsory Course (AECC 01)

Environmental Studies

L	T	P	C
3	0	0	3

Course Objectives:

1. To identify and solve the environmental problems.
2. To avoid environmental pollution & Global Problems.
3. To create awareness among the people about the protection of the environment.

Course Outcomes:

After successful completion of the course, students will be able to

1. Get knowledge about the different types of resources like land, water, mineral and energy.
2. Gain knowledge about the different types of pollutions and their control technologies.
3. Get information about the ecosystem and about its functions like Food chain, Ecological pyramids etc.

Theory

Unit-I: Introduction to environmental studies - Multidisciplinary nature of environmental studies; Scope and importance of environmental studies, Ecosystems, Structure and function of the ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystem: Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans). Natural Resources: Renewable and Non-renewable Resource, Land resources and land-use change; Land degradation, soil erosion and desertification. Water: Use and over-exploitation of surface and groundwater, conflicts over water (international & interstate). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources.

Unit-II: Biodiversity and Conservation- Levels of biological diversity: genetic, species and ecosystem diversity; values of biodiversity Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega---biodiversity nation; Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution & Policies - Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks, Solid waste management, Climate change, global warming, ozone layer depletion, acid rain, Environment Laws:

Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Unit-IV: Human Communities and the Environment - Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation project-affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Fieldwork activities (Study of simple ecosystems)

References

1. Textbook of Environmental Studies for undergraduate courses by Erach Bharucha.
2. Deswal, S. and Deswal, A. 2005. A Basic Course in Environmental Studies. Dhanpat Rai & Co Ltd., Delhi.
3. Singh, N. and Sontakke, N.A. 2002. On Climatic fluctuations and Environment changes on Indo-Gangetic Plains, India.
4. Deswal, S. and Deswal, A., 2003, Energy, ecology, Environment and Society, Dhanpat Rai & Co Ltd., Delhi.
5. Singh, G.B. and Sharma, B.R. 1998. Fifty Years of Natural Resource Management Research, Indian Council of Agriculture Research, New Delhi.

ABC 01 - INSTRUMENTATION & BIOANALYTICAL TECHNIQUES

L	T	P	C
0	0	2	2

Course Objectives: The Course

- Provides the knowledge on construction and working principle of various instruments.
- Imparts skills in handling and operations of various instruments.

Course learning outcomes: At the end of the course, the learners will be able to

1. Describe the working principle of colorimeter and spectrophotometer.
2. Explain the types of rotors and centrifugation techniques.
3. Understand the principles and applications of chromatography.
4. Demonstrate the techniques of electrophoresis.

PRACTICE

I. Institutional Visit to learn working principles of following instruments:

1. Spectrophotometry
2. Centrifugation: Differential centrifugation/ density gradient Centrifugation/ batch centrifugation/ ultracentrifugation.
3. Chromatography: Gel filtration chromatography/ ion-exchange chromatography/ affinity chromatography/ Gas Chromatography/ HPLC.
4. Electrophoresis: SDS- polyacrylamide gel electrophoresis/ 2D gel electrophoresis/ Agarose gel electrophoresis.

II. Report submission and PPT presentation on institutional visit (should include working principle of instruments learnt by student during the visit)

REFERENCES:

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7thEd., Cambridge University Press.
2. Nelson D L and Cox MM. (2008). Lehninger Principles of Biochemistry, 5thEd., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton CJ. (2013). Prescott, Harley, and Klein's Microbiology. 9thEd., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons.
5. Inc. De Robertis EDP and DeRobertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D. C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

Semester Three

DSC 05 – MICROBIAL PHYSIOLOGY AND METABOLISM

L	T	P	C
3	0	2	5

Course Objectives: The course

- Provides the knowledge of nutritional requirements and their uptake by microorganisms.
- Imparts the knowledge of understanding the growth, enzymes and factors affecting it.

Course Outcomes: At the end of the course, learners will be able to

1. **Identify** various nutritional requirements and types of microorganisms.
2. **Differentiate** the phases of growth and the techniques used for measuring growth.
3. **Appreciate** the role of enzymes in microbial physiology and the various mechanisms used by microorganisms for growth and survival.
4. **Understand** the effects of environmental factors on the physiology of microorganisms.

THEORY

UNIT- I MICROBIAL NUTRITION

- a) Nutritional requirements – micronutrients and macronutrients, Classification of microorganisms based on nutrition.
- b) Uptake of nutrients- Passive diffusion, Facilitated diffusion, Active transport, Group translocation, Iron uptake.

UNIT- II MICROBIAL GROWTH

- a) Growth rate and generation time, growth curve, phases of growth. Batch, Synchronous, Continuous and Diauxic growth. Physico-chemical factors affecting growth: molecular oxygen, temperature, pH, pressure, light, salt concentration, nutrients, metals,
- b) Methods of growth measurement: cell number, cell mass, cell size

UNIT – III ENZYMES

- a) Definition, Nomenclature, Classification, Properties, Mode and Mechanism of Enzyme action; Factors affecting enzyme action.
- b) Enzyme Inhibition: Competitive and Non-Competitive. Enzyme regulation: Allosteric enzymes-their importance, feedback inhibition; cofactors and coenzymes.

UNIT- IV SIGNAL TRANSDUCTION& STRESS PHYSIOLOGY

- a) Two-component signal transduction in prokaryotes – chemotaxis, quorum sensing, and biofilms
- b) Effect of oxygen, pH, osmotic pressure and heat shock on bacteria. Sporulation and germination of spores

PRACTICAL 05: MICROBIAL PHYSIOLOGY AND METABOLISM

1. Effect of temperature on the growth of microorganisms.
2. Effect of pH on the growth of microorganisms.
3. Effect of UV on the growth of microorganisms.
4. Effect of Phenol on the growth of microorganisms.
5. Effect of Heavy metals on the growth of microorganisms.
6. Effect of carbon sources on the growth of microorganisms
7. Demonstration of Catalase test and Urease test.
8. Determination of growth curve and measurement of bacteria by colorimetric or turbidometric method
9. Growth measurement using Haemocytometer

REFERENCES

1. Prescott LMJP, Harley, and CA Klein. (1995). Microbiology 2nd edition Wm, C. Brown Publishers.
2. Tortora, Funke and Case. Microbiology, 8th edition.
3. Doelle HW. (1975). Bacterial Metabolism. 2nd edition. Academic Press.
4. Moat AG, JW Foster. (1988). Microbial P hysiology. 2nd edition. Springer Verlag.
5. Caldwell DR. (1995). Microbial Physiology and Metabolism. Wm. C Brown Publishers, England.

DSC 06 - MICROBIAL METABOLISM

L	T	P	C
3	0	2	5

Course Objectives: The Course

- Imparts the knowledge on different metabolic processes among diverse group of microorganisms.
- Provides the knowledge on interconnections between the metabolic pathways.

Course Outcomes: At the end of the course, learners will be able to

1. **Understand** the metabolic pathways of aerobic respiration.
2. **Explain** the pathways related to anaerobic respiration and fermentation.
3. **Describe** chemolithotrophic and phototrophic metabolic pathways.
4. **Understand** the nitrogen and nucleic acid metabolism.

THEORY

UNIT-I CHEMOHETEROTROPHIC METABOLISM - AEROBIC RESPIRATION

- a) Definition of aerobic respiration, anaerobic respiration and fermentation.
- b) Sugar degradation pathways - EMP, ED, Pentose phosphate pathway, TCA cycle.
- c) Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors.

UNIT-II CHEMOHETEROTROPHIC METABOLISM- ANAEROBIC RESPIRATION AND FERMENTATION

- a) Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction).
- b) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

UNIT-III CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM

- a) Aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation reaction and methanogenesis.
- b) Phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria, and cyanobacteria.

UNIT-IV NITROGEN, FATTY ACID AND NUCLEOTIDE METABOLISM

- a) Nitrogen fixation – definition and types; Ammonia assimilation, nitrification, and denitrification.
- b) Fatty acid synthase complex, Fatty acid biosynthesis and degradation (α , β , and γ pathways)
- c) Nucleotide biosynthesis, degradation, and its regulation.

PRACTICAL 06: MICROBIAL METABOLISM

1. Acid and gas production from carbohydrates.
2. Starch and Gelatin hydrolysis.
3. Casein and Lipid hydrolysis.
4. Triple Sugar Iron (TSI) test.
5. IMViC Test.
6. Ammonification: Demonstration of ammonification using nitrogenous organic compounds.
7. Nitrification: Demonstration of nitrification by enzymatic conversion of ammonia to nitrate by soil microorganisms.
8. Denitrification: Demonstration of denitrification by the reduction of nitrates to nitrogen gas.

REFERENCES

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

OEC 03 - MICROBIAL ANALYSIS OF AIR & WATER

L	T	P	C
3	0	0	3

Course Objectives: The course

- Gives an overview of microbiological aspects of air and water.
- Discusses about the important air borne microorganisms, water borne pathogens, their sampling, detection, analysis techniques and control measures.

Course outcomes: At the end of the course, the learners will be able to

1. **Understand** and **explain** different airspora and nature of bioaerosols.
2. **Demonstrate** various air sampling techniques and their control measures.
3. Develop the knowledge to **analyze** quality of air and water.
4. **Describe** different water borne diseases and their implications.

THEORY

UNIT- I AEROMICROBIOLOGY

- a) Definition, History, Fundamentals of aerobiology, Factors affecting the distribution of microorganisms, indoor and outdoor airspora.
- b) Bioaerosols: Definition, types, and nature; Air borne microorganisms (viruses, bacteria, fungi) and their impact on human health and environment, significance in food, pharma and hospitals; allergens.

UNIT -II AIR SAMPLING AND ANALYSIS

- a) Indoor and outdoor sampling, working principle and procedure of air samplers and their limitations (Sedimentation, impaction, and impingement methods).
- b) Control Measures: inactivation mechanisms – fumigation, UV light, HEPA filters.
- c) Basic concepts of clean room technology.

UNIT -III AQUATIC MICROBIOLOGY

- a) Microbiology of water: Factors affecting the distribution of microorganisms, aquatic habitats (Lentic and Lotic).
- b) Sample Collection, Treatment, and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, Confirmed and completed tests for fecal coliforms (b) Membrane filter technique, (c) presence/absence coliform test, H₂S strip test, BOD, Biological indicators of water pollution.
- c) Control Measures - precipitation, chemical disinfection, filtration, high temperature, UV light.

UNIT- IV WATER BORNE DISEASES

Introduction to water borne diseases –

- a) Bacterial: Typhoid, Cholera, *Escherichia coli* O157:H7 Infection
- b) Protozoan: Giardiasis, Amoebic Dysentery
- c) Viral: Hepatitis A, Polio

REFERENCES

1. Microbiological Examination Methods of Food and Water A Laboratory Manual (2012) da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR. CRC Press
2. Microbial Ecology: Fundamentals & Applications (2000) Atlas RM and Bartha R. 4 th edition. Benjamin/Cummings Science Publishing, USA
3. Environmental Microbiology (2009) Maier RM, Pepper IL and Gerba CP. 2nd edition, Academic Press
4. Manual of Environmental Microbiology (2007) Hurst CJ, Crawford RL, Garland JL, Lipson DA 3rd edition, ASM

Language – Part I English III

Course Objectives:

L	T	P	C
3	0	0	3

- Learn the importance of Superfluous Expressions otherwise known as redundant or unnecessary expressions.
- Learn to use Active and Passive Voice in speech and writing and understand them.

Course Outcomes:

After successful completion of the course, students will be able to

1. Add variety to their writing through the use of conjunctions and articles so that they can be used to create sentences with different styles and meanings.
2. Add flexibility in their language by proper use of Active and Passive voice.
3. Successfully remove redundant and superfluous expressions in their speech and writing.
4. Express nuances in meaning by using modal auxiliary verbs.

Unit-I: Grammar

1. Correct use of Conjunctions
2. Correct use of Articles
3. Superfluous Expressions and commonly mispronounced words in English
4. Active and Passive Voice
5. Modal Auxiliaries
6. Reading Comprehension Passage

Unit-II: Vocabulary

1. Roots: M to R
2. Homonyms, homophones and homographs
3. Figures of Speech: Hyperbole, Euphemism, Onomatopoeia, Personification
4. Foreign expressions

Unit-III: Creative Writing

1. Paragraph writing
2. Précis Writing

Unit-IV: Essay

Sardar Vallabhi Bhai Patel's letter to Nehru after drafting the Constitution.

References:

1. Sudhir S Padhye, 2017. **English Grammar and Writing Skills**, Notion Press
2. S.P Bakshi, Richa Sharma, 2017. *Descriptive English*, Arihant Publication

Language – Part II English III

L	T	P	C
3	0	0	3

Course Objectives:

- Critically analyze American, Anglo American, Neoclassical and Victorian Poetry.
- Learn about the importance of historical fiction and diary entries.

Course Outcomes:

After successful completion of the course, students will be able to

1. Think and ponder about the plight of not only Jewish refugees but refugees all over the world and raise broader questions about isolation, loneliness, and exile.
2. Understand and appreciate the revolutionary and patriotic spirit of Bhagat Singh's last three years (1929-31) in Lahore's Central Jail, through Bhagat Singh's jail diary.
3. Learn about several life-changing lessons like revengeful instinct can only lead to one's doom and not to give up on life despite all hurdles.

Unit-I: American and Anglo American Poetry

1. "The Road Not Taken" by Robert Frost
2. "Refugee Blues" by W H Auden

Unit-II: Neoclassical and Victorian Poetry

1. "On His Blindness" by John Milton
2. "The Last Duchess" by Robert Browning

Unit-III: Drama, Historical Fiction and Diary Entries

1. "The Proposal" by Anton Chekov
2. "Remember the Roses" by Avery Taylor
3. Bhagat Singh's jail diary

Unit-IV: Epic Literature

"The Mahabharata"

References:

1. Chekhov Anton, 2017. The Very Best of Anton Chekov - Short Stories published by Embassy Books.
2. Sandhu Yadvinder Singh, 2020. Bhagat Singh's Jail Diary, Prabhat Prakashan.
3. Frost Robert, 1993. The Road Not Taken and Other Selected Poems, Wilder Publications.

Language – Part II Kannada III

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 3

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಮೂಡಿಸುವುದು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಓದಿಗೆ ಅನುವು ಮಾಡಿಕೊಡುವುದು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಹೊಂದುವರು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ವಿಸ್ತಾರ ಜ್ಞಾನ ಪಡೆಯುವರು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರಹದ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆವರು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು

ಘಟಕ – ೧, ಮಾನವೀಯತೆ

- ೧) ಸತ್ಯ ಶರಣೆ ಸಂಕಮ್ಪ : ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ
- ೨) ಚಂದ್ರಮತಿಯ ಪ್ರಲಾಪ : ರಾಘವಾಂಕ
- ೩) ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು : ಮಣಿಕಾಂತ್ ಎ.ಆರ್

ಘಟಕ – ೨, ಪ್ರವಾಸ ಸಾಹಿತ್ಯ

- ೧) ನನ್ನ ಗ್ರಹಿಕೆಯ ನೇಪಾಳ : ನಾಗತಿಹಳ್ಳಿ ಚಂದ್ರಶೇಖರ್

ಘಟಕ – ೩, ವಿಚಾರ ಕ್ರಾಂತಿ

- ೧) ಕತ್ತೆ ಮತ್ತು ಧರ್ಮ : ಡಾ. ಸಿದ್ದಲಿಂಗಯ್ಯ
- ೨) ವೈಚಾರಿಕತೆ : ಎಚ್. ನರಸಿಂಹಯ್ಯ
- ೩) ನಮ್ಮ ಅಳತೆಯನ್ನು ಮೀರಲಾರದ ದೇವರು : ಡಾ.ಕೆ. ಶಿವರಾಮ ಕಾರಂತ

ಘಟಕ – ೪, ಭಾಷಾ ಭಾಗ

- ೧) ಸುತ್ತೋಲೆ
- ೨) ಕಡತ (ಫೈಲುಗಳು) ಕಛೇರಿ ಟಿಪ್ಪಣಿಗಳು
- ೩) ಲೇಖನ ಚಿಹ್ನೆಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- ೧) ಹೊನ್ನೂರು ಜನಪದ ಗೀತೆಗಳು – ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ
- ೨) ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು: ಮಣಿಕಾಂತ್ ಎ.ಆರ್
- ೩) ತೆರೆದ ಮನ – ಡಾ. ಎಚ್ ನರಸಿಂಹಯ್ಯ
- ೪) ಆಡಳಿತ ಕನ್ನಡ – ಎಚ್‌ಎಸ್‌ಕೆ

Language – Part II French III

L	T	P	C
3	0	0	3

Course Objectives:

- This course aims to enable the learners to understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment).

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. local geography, employment, accommodation, health and illness)
2. Understand short, simple texts, incl. letters and everyday material (e.g. advertisement, menus, magazine articles, hotel webpages) related to areas of most immediate relevance (e.g. local geography, employment, holidays, consulting a doctor)
3. Communicate verbally in simple and routine tasks requiring simple and direct exchange of information on familiar and routine matters (e.g. asking where places are, finding your way around, visiting the doctor, renting an apartment)

Unit 1

1. Talk about yourself, your educational background, your job, your family, your neighborhood
2. Talk about your hobbies and daily activities

Unit 2

1. Ask for goods in a shop where goods are displayed
2. Order a meal in a restaurant if dishes are either displayed or illustrated on the menu

Unit 3

1. Book a hotel room (face to face)
2. Ask for basic services in a post office or bank

Unit 4

1. Indicate the nature of a medical problem to a doctor
2. Make inquiries about a journey at a travel agency

References:

1. Makowski Francois, 1995. Beginners French Made Easy with CD, Goyal Publishers & Distributors Pvt. Ltd.
2. Cantel JB., 1860. The Pronunciation of French Made Easy, Nabu Press

Ability Enhancement Compulsory Course (AECC - 02)

L	T	P	C
2	0	0	2

Indian Constitution

Course Objectives

- The course aims to imbue students with the process of constitutional making and its formulations. Further, it is offered with the objective to acquaint students to have the basic understanding of the constitution of India.

Unit I: Constitution – Structure and Principles

- Meaning and importance of Constitution
- Making of Indian Constitution
- Salient features of the Constitution

Unit II: Fundamental Rights and Directive Principles

- Fundamental Rights
- Fundamental Duties
- Directive Principles

Unit III: The Union Government

- President of India – Election & Powers
- Prime Minister and Council of Ministers
- Lok Sabha – Composition and Powers
- Rajya Sabha - Composition and Powers

Reference:

- 1) Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)
- 2) M. V. Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)
- 3) J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency, 2018 (55th edn.)
- 4) Constitution of India (Full Text), India. Gov. in., National Portal of India, https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
- 5) Durga Das Basu, Bharatada Samvidhana Parichaya, Gurgaon; Lexis Nexis Butter worths Wadhawa, 2015.
- 6) Kb Merunandan, Bharatada Samvidhana Ondu Parichaya, Bangalore, Meragu Publications, 2015.

Skill Enhancement Course (SEC 02) – Artificial Intelligence

Course Objectives:

L	T	P	C
0	0	2	2

Course Outcomes:

After successful completion of the course, students will be able to

Curriculum awaited from GoK

Semester Four

DSC 07 – MICROBIAL GENETICS

L	T	P	C
3	0	2	5

Course Objectives: The course

- Will impart knowledge about genetic materials, their structure and types, mechanism of replication of DNA.
- Provides the knowledge in gene concepts and genetic code, gene expression, gene regulation and learn about mutation.

Course outcomes: At the end of the course, the learners will be able to

1. **Describe** the nature and classify the types of genetic material.
2. **Explain** the mode and mechanism of DNA replication.
3. **Discuss** recombination processes in bacteria and understand the gene concept.
4. **Describe** gene expression concepts, mutation and types, damage, and repair mechanism and also importance of mutation.

THEORY

UNIT-I GENETIC MATERIAL- STRUCTURE AND TYPES

- a) Chemical Basis of heredity- Evidence for DNA and RNA as genetic material (Griffith experiment, Hershey Chase experiment, Avery, Mc Cleod and Mc Carty experiment).
- b) Watson and Crick model of DNA, DNA types (A, B and Z); Types of RNA- Structure and their significance.
- c) Prokaryotic and eukaryotic genome organization.

UNIT –II REPLICATION OF DNA

- a) DNA Replication- Unit of replication, enzymes involved, Mechanism of replication: replication origin and replication fork, fidelity of replication, extra chromosomal replicons.
- b) Modes of replication: Conservative, Semi-Conservative and Dispersive modes. Models of Replication in prokaryotes (Rolling circle, Theta replication)

UNIT- III RECOMBINATION IN BACTERIA AND GENE CONCEPT

- a) Genetic recombination; Transformation and its mechanism; Conjugation (F^+ , HFr, F') and Transduction (Generalized and Specialized).
- b) Gene concept, Gene-Protein relationship: One Gene-One enzyme and One gene –One polypeptide concept.

UNIT-IV GENE EXPRESSION, REGULATION AND MUTATIONS

- a) Genetic code- Features, Wobble hypothesis, Evolution of genetic code.
- b) Central dogma, Gene expression- Transcription and Translation, Regulation of gene expression in prokaryotes- Lac operon, Tryptophan operon.
- c) Nature and types of mutation, Mutagenic agents -Physical and Chemical mutagens.
- d) Damage and Repair of DNA- Photoreactivation and SOS repair.

PRACTICAL 07: MICROBIAL GENETICS

1. Isolation of streptomycin resistant mutant by Gradient-Plate Technique.
2. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
3. Preparation of Master and Replica Plates.
4. Demonstration of Bacterial transformation, conjugation and transduction
5. Study of the following through charts/photographs: A, B, Z-DNA, DNA replication, t-RNA, transcription, translation, transformation, transduction, conjugation.

REFERENCES

1. Gardner, E. J, Simmons, M J&D P Snustard, 1991, Principles of Genetics,8th edition. John Wiley & Sons. NY.
2. Freifelder.S,1987Microbial Genetics, Jones & Bartlett, Boston.
3. Robert H. Tamarin. Principles of Genetics ,5th edition, Cm Brown Publishers.
4. Lewin.B,1990. Genes,6th edition, Oxford University Press.
5. Klug. W. S. & Cummings, MR,1996, Essentials of Genetics, Mentics Hail. New Jersey. Benjamin Lewin, Gene VII, Oxford University Press, (2000).
6. GlickBR and PasternakJJ, Molecular Biotechnology, 2nd Ed.ASM press. (2003).
7. Uldis N.Streips, RonaldE. Yasbin. Modern Microbial Genetics.2nd EditionWiley-Liss,Inc.(2002).
8. Gardner E J, Simmons M J and Snupstad DP, Principles of genetics, 8th edition JohnWiley & Sons, (2006).
9. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Angelika Amon; Kelsey C. Martin, Stephen C. Harrison. Molecular Cell biology. Macmillan Higher Education.
10. David Freifelder.Essentials of molecular biology.Jones and Bartlett Publishers, 1998.

DSC 08 – RECOMBINANT DNA TECHNOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Introduces to Recombinant DNA Technology and familiarises with the tools and techniques.
- Creates understanding and expertise in wet lab techniques in genetic engineering.

Course outcomes: At the end of the course, the learners will be able to

1. **Summarize** the concepts of genetic engineering.
2. **Describe** the types of cloning vehicles and their applications.
3. **Understand** the concepts of cloning, selection and screening of clones.
4. **Demonstrate** different techniques in genetic engineering.

THEORY

UNIT- I GENETIC ENGINEERING

- a) Principles of gene manipulation- Definition & applications, Enzymes: Exonuclease, Endonuclease.
- b) Modifying enzymes: Restriction Enzymes – Discovery, nomenclature, types & mode of action; isoschizomers, neoschizomers; SI nuclease, DNA Ligases & Methylases. DNA polymerases.

UNIT -II CLONING VEHICLES

- a) Naturally occurring plasmids (psc 101, psc 2124, pmb1); Cloning plasmids, artificial vectors: pBR322 & pUC 18/19.
- b) Viruses as cloning vehicles: λ phage– insertion and replacement vector; Hybrid vectors: Cosmids, Phagemid, Phasmids, YAC, BAC.

UNIT –III GENE CLONING

- a) Cloning organisms (*E. coli*), construction of chimeric DNA (palindromic & staggered cleavage), dA-dT Tailing, Blunt end Ligation, DNA-Isolation (Phenol: Chloroform: Isoamyl alcohol), gel electrophoresis.
- b) Gene transfer techniques: Bacteria- transformation, transduction, electroporation; Plant Cells- Transfection, Ultrasonication (ultrasonicators), particle bombardment (Biolistics), Agroinfection, Liposome fusion; Animal Cells – Liposome mediated gene transfer, Virus Vector method, Microinjection.
- c) Screening & Selection of Recombinants in bacteria: Screening and selection of recombinants- Direct selection by complementation, Marker inactivation, Indirect methods – Immunological; Genetics methods: colony hybridization, Plaque lifting method.

UNIT- IV TECHNIQUES IN GENETIC ENGINEERING

- a) DNA libraries (Gene bank/genomic libraries; cDNA libraries) Blotting techniques (Southern, Northern, Western).
- b) DNA amplification: PCR (types & Applications) RAPD & RFLP and applications, Microarray.

PRACTICAL 08: RECOMBINANT DNA TECHNOLOGY

1. Isolation of bacterial / Fungal DNA.
2. Quantification of DNA by Spectrophotometer.
3. Agarose Gel Electrophoresis for separation of DNA.
4. Demonstration of PCR.
5. Blotting Techniques (Southern/ Northern/ Western).

REFERENCES

1. Old RW and Primrose. (1995). Principle of Gene Manipulation. 5th edition. Blackwell Scientific Publication, Boston.
2. Winnecker ED. (1987). From gene to clones, Introduction to Gene Technology.VCH Publication, FRG.
3. Brown TA. (1995). An introduction to Gene Cloning. 3rd. edition. Champman and Hall.
4. Glick BR and Pasternak JJ. (1994). Molecular Biotechnology. Principles and Application recombinant DNA. ASM Press, Washington.

OEC 04 – BIOFERTILIZERS AND BIOPESTICIDES

L	T	P	C
3	0	0	3

Course Objectives: The course

- Highlights the use of microorganisms as fertilizers in enrichment of soil fertility.
- Elucidates the knowledge on mass production of Biofertilizers, organic farming and biopesticides.

Course Outcomes: At the end of the course, the learners will be able to

1. **Explain** different microbes to be utilized as biofertilizer.
2. **Discuss** host plant and microbe association.
3. **Describe** the mass production of Biofertilizers and importance of organic farming.
4. **Understand** the types and applications of biopesticides.

THEORY

UNIT-I BIOFERTILIZERS

- a) Definition, types, microbes as biofertilizers.
- b) Symbiotic associates – Rhizobium taxonomy, PGPR; Physiology, Host cell – Rhizobium interactions, inoculants and mass cultivation.

UNIT -II MYCORRHIZA AND ACTINORRHIZA

- a) Frankia woodland and Actinornizal nitrogen fixing plants and its host plants, characteristics, identification, cultural method, and maintenance of Azospirillum, Azotobacter, Azolla and anabaena.
- b) Mycorrhiza: Definition, occurrence, types; VAM association - Collection, isolation and inoculum production.

UNIT -III MASS PRODUCTION OF BIOFERTILIZERS

- a) General outline of microbes as fertilizers, Carrier materials, large scale production of biofertilizer (*Rhizobium*, *Azotobacter*, *Azospirillum*, *Anabaena* in *Azolla*); Rhizosphere effect, microbial products influencing plant growth.
- b) Organic farming- Principles, Ecosystem and concepts, organic nutrient resource and their management, organic crop production and importance.

UNIT- IV BIOPESTICIDES

- a) Definition and types. Characteristics, physiology and Mechanism of action and applications: Virus- Baculovirus; Bacteria- *Bacillus thuringiensis*; Fungi- *Beauveria bassiana*. A brief account on nematodes as biopesticides.
- b) Integrated use of biofertilizers and biopesticides in crop production.

REFERENCES

1. Subba Rao, N.S. 2000 Soil Microbiology. Oxford and IBH Publishing Co.Ltd.
2. Verma A and Hock B. 1995. Mycorrhiza.
3. Yaacovokan, 1994 - Axospirillum, CBC press.
4. Wicklow, D.T. and B.E. Soderstrom. 1997, Environmental and microbial relationships. Springer.
5. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
6. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. NewYork.
7. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
8. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt.Ltd. NewDelhi.
9. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG
10. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

Language – Part I English IV

Course Objectives:

L	T	P	C
3	0	0	3

- Know the importance of CV Writing to display skills, education and work history.
- Build confidence and fluency, assess progress, and put learning into action by enacting role-plays.
- Boost conversational English skills by using idioms and proverbs.

Course Outcomes:

After successful completion of the course, students will be able to

1. Express certain ideas or opinions and improve creative writing by using idioms and proverbs.
2. Improve their interview preparation skills.
3. Create engaging and well-thought essays on current and relevant topics.
4. Understand that one should never be content with what is, nor consider oneself an expert, which is the message of Steve Jobs's "Stay Hungry, Stay Foolish".

Unit - I: Grammar

1. Report Writing (Magazine Report, News Report)
2. Preparing CV's and Facing Interviews: Do's and Don'ts.
3. Role Plays
4. Reading Comprehension Passage

Unit - II: Vocabulary

1. Roots: S to Z
2. Figures of speech: Pun, Oxymoron, Irony, Antithesis
3. Idioms and Proverbs
4. Phrasal Verbs

Unit - III: Creative Writing

1. Story Writing
2. Essay writing

Unit - IV: Essay

" Stay Hungry Stay Foolish", by Steve Jobs

References:

1. Hundiwalla S. (2012) Facing the Corporate Interviews Useful and Time-Tested Tips for Job Interviews in Multinational Companies published by Arihant Publishers.
2. Malhotra Jyoti (2014) IELTS - Vocal Cosmetics published by V&S publisher.
3. Bell James Scott (2017) How to Write Short Stories and Use Them to Further Your Writing Career.
4. Mitra Bashu (2006) Encyclopaedia of Idioms and Proverbs published by Anmol Publications Pvt Ltd.

Language – Part II English IV

Course Objectives:

- Learn about Modern and Post-Modern literature.
- Learn about the glory of the Vijayanagara Empire through chronicles of Paes.
- Learn about racial discrimination through African American writings.

L	T	P	C
3	0	0	3

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand and critically appreciate the century-old conflict between the Ruling class and the Artist community through “The Burning of the Books” by Bertolt Brecht
2. Comprehend that any person who is oppressed or "caged" will always continue to "long" for freedom, knowing that if others are entitled to it, they should be entitled to it, too through Maya Angelou's poem I Know Why a Caged Bird Sings.
3. Appreciate the glory of the Vijayanagara Empire through the travelogues of Paes.

Unit-I: Poetry from the Modern and Post-Modern periods

1. “The Burning of the Books” by Bertolt Brecht
2. “Birches” by Robert Frost

Unit-II: British and African American Literature

1. “Ah, Are You Digging on My Grave?” by Thomas Hardy
2. “I Know Why a Caged Bird Sings” by Maya Angelou

Unit-III: Indian English Literature, Travelogues and French Prose

1. “Eidgaah” by Munshi Prem Chand
2. Chronica dos reis de Bisnaga’ (Chronicles of the Vijayanagara Empire) by Paes
3. “La Parure” or “The Necklace” by Guy de Maupassant

Unit IV: British Drama

“The Dear Departed” by Stanley Houghton

References:

1. Robert Frost (1993) The Road Not Taken, Birches, and Other Poems published by Coyote Canyon Press.
2. Munshi Prem Chand (1969) Selected Short Stories published by Maple Press.
3. Guy De Maupassant (1992) The Necklace and Other Stories published by Vishv Books Private. Ltd.
4. Stanley Houghton (2018) The Dear Departed published by Palala Press.

Language – Part II Kannada IV

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – ೪

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳಲು ಅನುವು ಮಾಡಿಕೊಡುವುದು
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಪಡೆದುಕೊಳ್ಳುವರು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಸಂಪಾದಿಸುವರು

ಘಟಕ – ೧, ದಮನಿತ ಲೋಕ

೧) ಚಂದ್ರಗಿರಿ ತೀರದಲ್ಲಿ : ಸಾರಾ ಅಬೂಬಕ್ಕರ್

ಘಟಕ – ೨, ಸಹಿಷ್ಣುತೆ

೧) ಸಹಿಷ್ಣುತೆ ಸಾರುವ ವಚನಗಳು : ಬಸವಣ್ಣ, ಮಡಿವಾಳ ಮಾಚಯ್ಯ

೨) ಕುಲ ಕುಲವೆಂದು ಹೊಡೆದಾಡದಿರಿ : ಕನಕದಾಸರು

೩) ಬುರ್ಖಾ : ಫಕೀರ್ ಮಹಮ್ಮದ್ ಕಟ್ಟಾಡಿ

ಘಟಕ – ೩, ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು

೧) ಕೊನೆಯ ಗಿರಾಕಿ : ನಿರಂಜನ

೨) ವಾಣಿಯ ಸಮಸ್ಯೆ : ಕೊಡಗಿನ ಗೌರಮ್ಮ

೩) ಮಾರಿಕೊಂಡವರು : ದೇವನೂರು ಮಹಾದೇವ

ಘಟಕ – ೪, ಭಾಷಾಭಾಗ

೧) ಜಾಹೀರಾತು ಹಾಗೂ ಜಾಹೀರಾತುಗಳ ಮಾದರಿ ರಚನೆ

೨) ಕರಪತ್ರ (ಪಾಂಪ್ಲೆಟ್), ಭಿತ್ತಿ ಪತ್ರ (ಪೋಸ್ಟರ್), ಫಲಕ ಬರಹ

೩) ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನ, ಕನ್ನಡ ಮತ್ತು ಅಂತರ್ಜಾಲ

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

೧) ಸುಳಿ – ಸಾರಾ ಅಬೂಬಕ್ಕರ್

೨) ಸಣ್ಣ ಕಥೆಗಳು: ಕಂನಾಡಿಗ ನಾರಾಯಣ

೩) ಕನಕ ದಾಸರ ಕೀರ್ತನೆಗಳು ಮತ್ತು ಮುಂಡಿಗೆಗಳ – ಪ್ರೊ. ಸುಧಾಕರ

Language – Part II French IV

L	T	P	C
3	0	0	3

Course Objectives:

- Students are taught to communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters.
- Students are taught to describe in simple terms the aspects of his/her background, immediate environment and matters in areas of immediate basic need.

Course Outcomes:

After successful completion of the course, students will be able to

1. Communicate in writing in simple and routine tasks requiring simple and direct communication of information on familiar and routine matters (e.g. applying for a job, booking a room by email, making an appointment)
2. Demonstrate knowledge and understanding of key aspects of the culture of the target language (e.g. food, festivities)
3. Use basic grammar in simple and routine tasks requiring direct communication of information on familiar and routine matters, as well as articulating personal opinions
4. Use high frequency vocabulary related to areas of immediate relevance (e.g. personal and family information, school/work, leisure, general culture).

Unit I

1. Use public transport (buses, trains and taxis)
2. Ask your way and give directions

Unit II

1. Buy tickets
2. Read notices, posters, catalogues, timetables, brochures, menus, advertisements, signs

Unit III

1. Write notes and simple messages
2. Note down times, dates and places from notice boards and announcements

Unit IV

1. Note down instructions and requests such as client orders and delivery dates.
2. Describe events and daily activities

References:

1. Dr. Ramesh Chilukuri, 2020. Breathe French: Learning made as easy as Breathing published by Prowess Publishing.
2. Beaujolie Florence, 2019. French Made Easy 2 in 1 published by M & M Limitless Online Inc.

Skill Enhancement Course (SEC 03) – Cyber Security

L	T	P	C
2	0	0	2

Course Objectives:**Course Outcomes:**

After successful completion of the course, students will be able to

Curriculum awaited from GoK

L	T	P	C
0	0	2	2

ABC 02 – CLINICAL MICROBIOLOGY

Course Objective: The course

- Provides knowledge on the types of infections of different organ system
- Imparts knowledge on sample collection and processing, and emphasizes on the common cause of infections

Course Outcome: At the end of the course, the learners will be able to

1. **Explain** the cause of blood stream infections.
2. **Differentiate** between upper and lower respiratory tract infections.
3. **Understand** central nervous system infections.
4. **Discuss** Gastrointestinal and Urinary tract infections

PRACTICE– ABC 02: Clinical Microbiology

I. Visit to clinical / Hospital to observe the clinical microbiology laboratory practices:

1. Smear preparation and staining.
2. Culture media & isolation of pure culture.
3. Direct microscopic examination – wet mount technique.
4. Identification of medically important yeast.
5. Identification of staphylococcus pathogens – Catalase and Coagulase test.
6. Identification of streptococcus pathogens - Haemolytic activity.
7. Identification of Enterobacteriaceae – IMVIC, TSI.
8. Antibiotic Susceptibility test.

II. Report submission through PPT presentation/report.

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4. Sastry AS and Bhat S. Essentials of Medical Microbiology. Jaypee Brothers Medical Publishers
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6. Collee JG, Fraser AG, Marmion BP, Simmons A. Mackie and McCartney. (2007). Practical Medical Microbiology. 14th Edition. Elsevier.
7. Cheesebrough, District Laboratory Practice in Tropical Countries: Part – 1.
8. Cheesebrough, District Laboratory Practice in Tropical Countries: Part – 2.

Semester Five

DSC 09 – ENVIRONMENTAL MICROBIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Will make the students aware of factors and adaptive mechanisms that affect the presence of microorganisms in fresh and marine water environment.
- Introduces to different microorganisms of importance in sewage systems; provide information on ecology of fresh water and polluted water.
- Provide knowledge about the different water purifications and microbiological examinations of water.

Course Outcome: At the end of the course, the learners will be able to

1. **Understand** the distribution of microorganisms in different atmospheric layers and method of air sampling.
2. **Explain** the microbes in aquatic habitat **and demonstrate** the water purification techniques.
3. **Describe** the different sewage treatment processes.
4. **Discuss** the types and treatment of solid wastes.

THEORY

UNIT-I AEROMICROBIOLOGY

- a) Layers in atmosphere, sources of air spora, distribution of microbes in air, indoor air spora – die away concentration; air spora of different environment; outdoor airspora - effects of environmental factors on air spora, aerosol, droplet nuclei.
- b) Air sampling techniques: sedimentation, impingement and impaction methods, air pollution-sources (Microbiological).

UNIT-II MICROBIOLOGY OF WATER

- a) Aquatic habitats - their microflora and fauna - lake, ponds, river, estuary, and sea. Influence of environmental factors on the aquatic biota.
- b) Municipal water treatment - Primary, secondary, and tertiary (Screening, straining, aeration, sedimentation, coagulation, flocculation, clarification, filtration and disinfection).
- c) Microbial assessment of water – MPN test, Membrane filtration test, Presence-Absence Coliform test, H₂S strip test.

UNIT-III SEWAGE MICROBIOLOGY

- a) Introduction: Sources of wastewater- domestic, agricultural, and industrial, physical, chemical and microbiological characteristics of wastewater.
- b) Waste water treatment: Single dwelling unit – septic tank: municipal waste water treatment- Primary (screening, coagulation and sedimentation), secondary (trickling filter, activated sludge process, oxidation pond), Tertiary (reverse osmosis, ion exchange method) and reclamation of wastewater. Industrial effluent management.

UNIT IV SOLID WASTE MANAGEMENT

- a) Types of solid wastes, Characterization of solid wastes, key components of solid waste management. Industrial solid waste management.
- b) Treatment of solid wastes (on-site and off-site disposal methods) – Landfilling, Incineration, composting, vermicomposting, silage, pyrolysis and saccharification.

PRACTICAL 09: ENVIRONMENTAL MICROBIOLOGY

1. Isolation of air borne microorganisms by petriplate exposure method.
2. Standard analysis of water for detection of coliforms- Determination of MPN.
3. H₂S strip test to assess water quality.
4. Biological indicators of water pollution.
5. Determination of pollution by measuring BOD/COD of different effluents.
6. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved.
7. Industrial/organizational/ Institutional Visit (WTP and STP).

REFERENCES

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DSC 10 – FOOD & DAIRY MICROBIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Provides knowledge about microbes present in food and their spoilage.
- Imparts the knowledge about food preservation techniques, food borne infection and their control.
- Provides the knowledge about the microbiology of milk, fermented dairy products and preservation of milk.

Course Outcome: At the end of the course, learners will be able to:

1. **Explain** the role of microbes in food spoilage and beneficial effects of microbes in foods and comprehend the factors influencing microbial growth and survival in foods
2. **Explain** and **demonstrate** the principles and various methods of food preservation
3. **Describe** the significance of food borne diseases in association with public health and **experiment** the methods of control of such infections and understand the importance of food sanitation and HACCP and quality systems.
4. **Explain** the microbiology of milk and other dairy products and microbes involved in dairy and fermented dairy products and **experiment** the methods of detection of microbial contamination and preservation of milk.

THEORY

UNIT- I MICROBES IN FOOD, AND SPOILAGE OF FOOD

- a) Microbial flora in food (Bacteria, mold, and yeast) and sources of food contamination.
- b) Intrinsic and extrinsic factors that affect growth and survival of microbes in foods
- c) Spoilage of food: cereals, vegetables, fruits, egg, milk, canned foods.

UNIT -II TECHNIQUES OF FOOD PRESERVATION

- a) Physical methods: Pasteurization, High temperature and Canning; Low temperature: Refrigeration, Freezing (slow and quick freezing).Drying: Solar drying, Rotary drum drying, Spray drying. Radiation: UV-rays, Cathode rays, Gamma rays.
- b) Chemical methods: Chemical preservatives: Propionates, Benzoates, Sorbates, Nitrates and Nitrites, Sulphur dioxide and sulphites, sugar and salt, wood smoke.

UNIT- III FOOD BORNE INFECTION, INTOXICATION, QUALITY CONTROL & DETECTION

- a) Bacterial intoxication & infection: Staphylococcal intoxication, Botulism Salmonellosis, Shigellosis, Campylobacteriosis. Mycotoxins-origin, types. A general account on aflatoxin.
- b) Microbiology of the food product: HACCP. A brief account on FDA, Indices of food sanitary quality and sanitizers.
- c) Detection of Food-borne Microorganisms: 1) Culture, Microscopic and Sampling methods: SPC, DEFT, MPN and Dye Reduction. 2) Chemical method: Thermostable nuclease *Limulus* Lysate for Endotoxins, Adenosine Triphosphate Measurement, Radiometry, and Fluoro-and

Chromogenic substrates. 3) Molecular Genetic methods: Nucleic Acid (DNA) probes, DNA Amplification (PCR), 4) Immunologic Methods: Fluorescent Antibody, Enrichment Serology, Salmonella 1-2 Test, Radioimmunoassay, ELISA.

UNIT IV- DAIRY MICROBIOLOGY

- a) Microbiology of raw milk, Hygienic milk production, Biochemical changes in milk.
 - b) Methods to detect microbial contamination in milk by SPC, Reductase test.
 - c) Starter culture- Salient features, Types of starter culture.
 - d) Fermented dairy products- Types, preparation, and importance of the following: cheese, yoghurt, condensed milk, whole and skimmed milk powder, ice-cream.
- Methods of preservation of milk and milk products

PRACTICAL 10: FOOD & DAIRY MICROBIOLOGY

1. Isolation of food borne bacteria from food products.
2. Isolation of microorganisms from spoiled vegetables/fruits.
3. Preparation of Yoghurt.
4. Seed quality testing by Blotter's method.
5. Breeds count and Standard plate count methods.
6. Milk quality analysis: MBRT, turbidity test, alkaline phosphatase.
7. Study of the following: cheese, condensed milk, whole and skimmed milk powder, Spray drier, Rotary drum drier.

REFERENCES

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6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
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DSC 11 – AGRICULTURAL MICROBIOLOGY

L	T	P	C
3	0	1	4

Course Objectives: The course

- Introduces the characteristics of soil environment, and factors affecting the distributions of microorganisms in the soil.
- Provides the knowledge of biofertilizers and biopesticides.

Course Outcome: At the end of the course, learners will be able to:

1. **Understand** the factors influencing presence and activities of microorganisms in different soils.
2. **Explain** microbial decomposition of organic matter and biogeochemical cycles.
3. **Demonstrate** the mass production of different biofertilizers.
4. **Identify and describe** the post-harvest diseases and their management.

THEORY

UNIT-I SOIL MICROBIOLOGY

- a) Distribution of microorganisms in nature –Microbial communities in soil-factors influencing the microbial density in soil-zymogenous and autochthonous flora in Soil.
- b) Microbial associations–mutualism, symbiosis, proto-cooperation, ammensalism, commensalism, syntropism, parasitism and predation with suitable examples.

UNIT-II MICROBIAL DECOMPOSITION

- a) Cellulose, Hemicellulose, lignin, pectin and chitin. –Factors influencing degradation. Microorganisms in the decomposition of organic matter.
- b) Biogeochemical cycles: Carbon cycle, Nitrogen cycle (Symbiotic and non-symbiotic), Phosphorous cycle, Sulphur cycle.

UNIT III MASS PRODUCTION OF BIOFERTILIZERS

- a) *Rhizobium*, *Azotobacter*, *Azospirillum*, VAM, Phosphobacteria, *Azolla*, Cyanobacteria.
- b) Mass production of Biopesticides – *Bacillus thuringensis*, *Trichoderma*, *Beauveria bassiana*, nuclear polyhedrosis viruses (NPVs), cytoplasmic polyhedrosis viruses (CPVs) and granular viruses (GVs)

UNIT- IV POST-HARVEST DISEASES AND THEIR MANAGEMENT

- a) Bacterial and fungal rots, non pathogenic diseases, mode of infection and factors influencing post-harvest diseases (harvesting, handling, packaging, transport, storage, temperature and relative humidity)
- b) Control of Pre-Harvest Infection; Strategies for Post-Harvest Disease Control (Orchard Management, Disinfection and Washing, Post harvest chemical treatment, Fumigation, Fruit wraps, Waxing, Coating and Packing, heat treatment, low temperature, irradiation and controlled atmosphere.)

PRACTICAL 11: AGRICULTURAL MICROBIOLOGY

1. Isolation and identification of bacteroides from root nodules.
2. Mass production of biofertilizer - *Azolla*.
3. Mass production of biopesticide - *Trichoderma*.

4. Isolation of bacteria and fungi from soil sample.
5. Detection of seed borne fungi by blotter's method.
6. Study of Anabaena in Azolla

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1. Dubey RC and Maheswari DK. (2016). A Textbook of Microbiology. S Chand & Company Pvt. Ltd.
2. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego.
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10. Barton LL and Northup DE. (2011). Microbial Ecology. 1st edition. Wiley Blackwell, USA

DSE 01a – IPR, BIOSAFETY & BIOETHICS

L	T	P	C
3	0	0	3

Course Objectives: The course

- Provides with sound theoretical knowledge on intellectual property rights, biosafety and bioethics.
- Imparts the knowledge on patent filing and types of patents.

Course Outcomes: At the end of the course, the learners will be able to,

1. **Explain** about patents, patent laws, agreements, concepts of patents.
2. **Understand** the treaties, agreements, and amendments in IPR.
3. Critically **analyze** the patent applications for novelty and utility.
4. **Describe** various biosafety levels, regulations of biosafety and bioethics.

THEORY

UNIT -I INTRODUCTION TO INTELLECTUAL PROPERTY IPR

- a) Definition and types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.
- b) IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies.
- c) WTO - Definition and Functions; Forms of IPR Protection.

UNIT- II AGREEMENTS AND TREATIES

- a) History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty.
- b) PCT; Indian Patent Act 1970 & recent amendments.

UNIT -III PATENT, FILING AND INFRINGEMENT

- a) Types of patents, Patent application- types (Provisional and complete specifications), forms and guidelines, fee structure, time frames; Precautions before patenting- disclosure/non-disclosure,
- b) Databases- Country-wise patent searches [USPTO, esp@cenet (EPO), PATENT Scope (WIPO), IPO, etc.].

UNIT -IV BIOSAFETY AND BIOETHICS

- a) Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Biosafety in relation to transgenic research and applications.
- b) Bioethics: Definition, Animal ethics; Norms in India, Licensing of animal house, Ethical clearance norms for conducting studies on human subjects.

REFERENCES

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007
3. Gurumani, N. Research Methodology,; For Biological Sciences . MJP Publishers, Chennai 2006
<http://www.w3.org/IPR/>
<http://www.wipo.int/portal/index.html.en>
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/
<http://www.cbd.int/biosafety/background.shtml>
<http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm>
<http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>

DSE 01b–BIOREMEDIATION & MICROBIAL TECHNOLOGY

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Provides the knowledge on the types of bioremediations, bioleaching and extraction of metals from ores using microbes.
- Introduces students to the application of microorganisms in several biotechnological techniques in pharma industries and in SCP production.

Course Outcomes: At the end of the course, the learners will be able to

1. **Identify** the microorganisms useful in the field of bioremediation.
2. **Understand** and **explain** the principles of various techniques used in studying mechanism of microorganisms involved in degradation of environmental pollutants.
3. **Discuss** the potential application of microorganisms in various pharmaceutical industries and **demonstrate** the algal cultivation for SCP production.
4. **Describe** the applications of microbial enzymes in the field of therapeutics and diagnostics.

THEORY

UNIT-I BIOREMEDIATION

- a) Introduction to microbial bioremediation: Definition, microbial approaches to bioremediation. Types of bioremediations- In Situ and Ex situ.
- b) Mechanism of bioremediation. Factors affecting bioremediation, Bioremediation - Advantages and disadvantages.

UNIT-II MICROBIAL LEACHING

- a) Bioleaching of metals from ores. biomagnifications, bioaccumulation of metallic and non-metallic components. Microbial degradation of pesticides, heavy metals and other Xenobiotics.
- b) Microbial enhanced oil recovery (MEOR), Phytoremediation of air pollutants.

UNIT -III BIOTECHNOLOGICAL POTENTIALS OF MICROALGAE

- a) Introduction to microalgae; Food – feed – fuel and pharmaceutically valuable compounds. Biofuels, Microbial hydrogen production.
- b) Cultivation methods of algae with reference to Dunaliella. Single cell protein – Chlorella, Spirulina, Yeasts, Mushrooms, SCP from wastes. Economic implications of SCP.

UNIT- IV MICROBIAL PRODUCTION OF ENZYMES

- a) Introduction to microbial enzymes; Types: cellulase, lipase, taq polymerase and restriction endonuclease. Production of therapeutic enzymes and diagnostic enzymes.
- b) Enhancement of enzyme activity uses of engineered protein, advantages of protein engineering.

REFERENCES

1. Bioremediation by Baker K.H. And Herson D.S. 1994..MacGraw Hill Inc. N.Y.
2. Biodegradation and Bioremediation, Academic Press, San Diego.
3. Genetics and Biotechnology of Industrial Microorgansims by C.l. Hershnergey, S.W. Queener and Q.Hegeman. Publisher. ASM. Ewesis ET. Al. 1998. Bioremediation Principles. Mac Graw Hill.
4. Balasubramaniam D, Bryce CFA, Dharmalingam K, Green J, Jayaraman K. (1996). Concepts in Biotechnology, University Press, India. Borowitzka MA,
5. Borowitzka LJ (1989) Microalgal technology, Cambridge University Press

SEC 04: BASICS OF BIOINFORMATICS

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Introduces the basic concepts of Bioinformatics and its significance in biological data analysis.
- Discusses the overview about biological macromolecular structures and structure prediction methods.

Course Outcome: At the end of the course, the learners will be able to

1. **Describe** the scope, importance, and application of bioinformatic tools.
2. **Explain** about the methods to characterize and manage the different types of Biological data.
3. **Classify** different types of Biological Databases.
4. **Analyze** the nucleotide and protein sequence data.

THEORY

UNIT - I INTRODUCTION TO BIOINFORMATICS

- a) Introduction to bioinformatics and data generation What is bioinformatics and its relationship with molecular biology. Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, PubMed, PDB) and software (RASMOL, Ligand Explorer).
- b) Data generation; Generation of large-scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray). Applications of Bioinformatics.

UNIT - II BIOLOGICAL DATABASE

- a) Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources.
- b) Biological Databases: General introduction of databases, Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

UNIT - III DATA ANALYSIS TOOLS

- a) Data storage and retrieval and Interoperability Flat files, relational, object-oriented databases and controlled vocabularies. File Format (GenBank, DDBJ, FASTA, PDB, SwissProt).
- b) Structural databases: Protein Data Bank (PDB), Nucleic Acid Data Bank (NDB), Molecular Modelling Data Bank (MMDB).

UNIT - IV SEQUENCE ALIGNMENTS AND VISUALIZATION

- a) Introduction to Sequences, alignments, and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).
- b) Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

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1. Becker, W. M., Kleinsmith, L. J., Hardin, J., & Raasch, J. (2003). *The world of the cell* (Vol. 6). San Francisco: Benjamin Cummings.
2. Claverie, J., M., Notredame, C. (2003). *Bioinformatics: A Beginner's Guide*. Wiley India Pvt. Limited.
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Value Based Course (VBC) 02 – Ethics & Self Awareness

L	T	P	C
2	0	0	2

Curriculum awaited from GoK

Semester Six

DSC 12 – MEDICAL MICROBIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Provides the knowledge of normal flora, types of infection and pathogenesis and summaries the various clinical microbiological techniques like sample collection, diagnosis and nosocomial infections.
- Imparts knowledge about pathogenesis of various diseases and the mode of action of antibiotics and drug resistance mechanism.

Course Outcomes: At the end of the course learners will be able to

1. **Explain** the human microflora and types of infection and describe the pathogenesis and virulence factors.
2. **Demonstrate** various lab techniques and distinguish the nature of nosocomial infections.
3. **Classify** various microbial diseases and their management and treatment strategies.
4. **Explain the** mechanism, mode of actions and application of antimicrobial agents and **understand**
 - i. the nature of drug resistance.

THEORY

UNIT- I INFECTION AND PATHOGENESIS

- a) History and Development of Medical Microbiology; Normal flora of human body
- b) Infection- Types of infection, modes of transmission, portals of entry; pathogenesis, virulence, attenuation, and exaltation with an example each.
- c) A brief account on gut microbiota.

UNIT- II INFECTIOUS DISEASES

Pathogen- Morphology, cultural characteristics, classification, pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following human diseases:

- a) Viral- Poliomyelitis, Hepatitis, HIV, COVID-19.
- b) Bacterial- Typhoid, Syphilis, Tuberculosis, Anthrax
- c) Fungal- Cutaneous mycoses: Tinea pedis (Athlete's foot), Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis
- d) Protozoan- Malaria, Amoebic dysentery, Leishmaniasis.

UNIT- III CLINICAL MICROBIOLOGY & NOSOCOMIAL INFECTIONS

- a) Laboratory specimens: Types, collection, handling, and transport of different clinical specimens.
- b) Diagnosis: principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).
- c) Nosocomial infections: definition, common types, sources, and reservoirs of hospital acquired infections.

UNIT- IV ANTIMICROBIAL AGENTS

- a) General characteristics and mode of action:
 - 1. Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism
 - 2. Antifungal agents: Amphotericin B, Griseofulvin
 - 3. Antiviral agents: Amantadine, Acyclovir, Azidothymidine
- b) Antibiotic resistance: definition and types, MDR, XDR, TDR, MRSA, NDM-1

PRACTICAL 12: MEDICAL MICROBIOLOGY

- 1. Study and isolation of normal flora of skin.
- 2. Study and isolation of microorganisms from Mouth- Teeth crevices (oral cavity).
- 3. WBC and RBC total count in a given blood sample.
- 4. Detection of typhoid by WIDAL test and syphilis by RPR test.
- 5. Antibiotic sensitivity test by Kirby-Bauer method
- 6. Study of the following: Human pathogens: *Mycobacterium tuberculosis*, *Salmonella typhi*, *Bacillus anthracis*, *Treponema pallidum*, *Hepatitis virus*, *HIV*, *Candida albicans*, *Plasmodium*, *Entamoeba histolytica*.

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DSC 13 – PRINCIPLES OF IMMUNOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Provides overview of immune system, innate and adaptive immunity along with major cells and molecules involved.
- Integrates immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction.

Course Outcomes: At the end of the course, the learners will be able to

1. **Understand** how the immune system develops and how the body defends itself against disease.
2. **Explain** various tissues, cells and molecules involved in host defense.
3. **Apply** knowledge of antigen–antibody reactions to carry out laboratory tests
4. **Implement** the usefulness of immunology in different pharmaceutical companies

THEORY

UNIT -I IMMUNE SYSTEM

- a) 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.
- b) Immunity: Types – Innate immunity: (nonspecific) physical, biochemical and genetic factors involved in governing innate immunity, molecules of innate immunity – complement, acute phase proteins and interferons; Chemokines and Cytokines. Acquired immunity: (specific) natural, artificial, passive immunity, humoral or antibody mediated immunity, cell mediated immunity

UNIT -II ANTIGENS AND ANTIBODIES

- a) Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Super antigen; Hapten; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants.
- b) Structure, Types, Functions and Properties of antibodies. Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies.

UNIT- III MAJOR HISTOCOMPATIBILITY COMPLEX, COMPLEMENT SYSTEM, IMMUNE RESPONSE

- a) Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways); Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways).

- b) 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).

UNIT -IV IMMUNOLOGICAL DISORDERS AND TECHNIQUES

- a) Types of Autoimmune responses and Autoimmune diseases. Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak-Higashi syndrome, Leukocyte adhesion deficiency, Chronic Granulomatous Disease.
- b) Immunological Techniques: Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy.

PRACTICAL 13: PRINCIPLES OF IMMUNOLOGY

1. Identification of human blood groups.
2. Differential leukocyte count of the given blood sample.
3. Separation of serum from the blood sample (demonstration).
4. Agglutination based tests: Rheumatoid arthritis, C-reactive protein,
5. Precipitation based test: Immunodiffusion by Ouchterlony method
6. Separation of monocytes from the blood sample and to study their adherence to glass surface.
7. Studies on histopathology of normal and infected tissue

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DSC 14 – INDUSTRIAL MICROBIOLOGY

L	T	P	C
3	0	1	4

Course Objectives: The course

- Highlights the importance of microorganisms in the production of useful human products.
- Introduces the various concepts of fermentation, role microorganisms in fermentation process.

Course Outcomes: At the end of the course, the learners will be able to

1. **Understand** the various concepts of fermentation process and media
2. **Screen, identify and select** potent microbial strain for fermentation processes.
3. **Acquire** the knowledge of types and operation of bioreactors.
4. **Describe** the product recovery process.

THEORY

UNIT -I FERMENTATION TECHNOLOGY

- a) Introduction, history, fermentation processes (Biomass, enzymes and metabolites), Process components.
- b) Fermenting media formulation - Raw materials, substrates used as carbon and nitrogen source, growth factors (Molasses, Corn steep liquor, sulphite waste liquor, whey and growth factors, precursors, buffers, inhibitors and antifoam agents), Sterilization of media.

UNIT- II FERMENTATION PROCESS

- a) Microbial culture selection – Isolation (primary and secondary screening techniques), maintenance (Repeated subculturing, Storage under liquid nitrogen, Dried cultures, lyophilization, use of mineral oil, Storage in soil, Use of silica gel).
- b) Development of microorganisms by strain improvement (mutation, genetic recombination, and genetic engineering).

UNIT- III BIOREACTORS

- a) Design and operation of Bioreactors, components of a fermenter, Basic concepts for selection of a reactor, Fermentation types (Solid state and submerged fermentation).
- b) Modes of operating a fermenter (Batch, continuous and fed-batch type), Sterilization of fermenter and nutrients, computer application in fermentation technology

UNIT -IV PRODUCT RECOVERY

- a) Down Stream processing: Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two-phase separation, solvent extraction, chromatography and electrophoresis.
- b) Product recovery – Penicillin, citric acid, wine, beer, amylase, SCP (Spirulina).

PRACTICAL 14: INDUSTRIAL MICROBIOLOGY

1. Grape wine preparation.
2. Estimation of alcohol by specific gravity method.
3. Screening and isolation of amylase producing fungi from different sources.
4. Isolation of industrially important microorganisms - Yeasts/ Lactic acid bacteria.
5. Solid state fermentation for mushroom production.
6. Separation of protein using organ acid/ Separation of protein by precipitation using salts.

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4. Maheshwari DK, Dubey RC and Saravanamtu R. (2010). Industrial Exploitation of Microorganisms. I.K. International Publishing House. New Delhi.
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L	T	P	C
3	0	0	3

DSE 02a – MICROBIAL BIOTECHNOLOGY

Course Objectives: The course

- Provides the knowledge of the wide applications of microorganisms in biotransformation processes.
- Enables to understand the potential of microbes in rDNA technology to manufacture genetically engineered therapeutics.

Course Outcomes: At the end of the course, learners will be able to

1. **Explain** the importance of microbes in biotechnological applications
2. **Demonstrate** the application of microorganisms in the production of vaccines, antibiotics and biofertilizers.
3. **Demonstrate** the role of microorganisms in biotransformation industries.
4. **Appraise** the role of microorganisms in industrial productions and also an understanding of advance technologies in microbial biotechnology.

THEORY

UNIT -I MICROBIAL BIOTECHNOLOGY AND ITS APPLICATIONS

- a) Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
- b) Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast

UNIT -II RECOMBINANT MICROBIAL PRODUCTION PROCESSES

- a) Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of biopesticides, bioplastics; Microbial biosensors.
- b) Applications & Microbial production of Antibiotics- Penicillins, Cephalosporins, Streptomycin, Tetracyclines & Griseofulvin. Microbial production of Vitamins- Vit B12, Riboflavin & Vit C.

UNIT- III APPLICATIONS OF MICROBES IN BIOTRANSFORMATIONS

- a) Types of Biotransformation reactions. Microbial based transformation of steroids and sterols; Biocatalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.
- b) Biotransformation for production of ascorbic acid & indigo

UNIT- IV MICROBES FOR BIO-ENERGY AND ENVIRONMENT

- a) Commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture.
- b) RNAi and its applications in silencing genes, drug resistance, therapeutics, and host pathogen interactions

REFERERNCES

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DSE 02b – ANTIMICROBIAL RESISTANCE

L	T	P	C
3	0	0	3

Course Objectives: The course

- Provides information on the evolution of antibiotics, criteria to select antimicrobial, usage, and their resistance surveillance.
- Gives the knowledge of antimicrobial resistance and the measures to control.

Course Outcomes: At the end of the course, the learners will be able to

1. **Understand** the knowledge of antibiotics and **analyze** the current situation and where we are heading due to antimicrobial resistance.
2. **Describe** the types of antimicrobials and their mode of action.
3. **Demonstrate** antibiotics sensitivity and resistance test
4. **Analyze** the problem of antimicrobial resistance and alternative approaches to fight the drug-resistant pathogens.

THEORY

UNIT- I ANTIBIOTICS

- a) Introduction: Discovery of Antibiotic; Definition – Antibiotics, Antimicrobial agents - antibacterial, antiviral, antifungals and antiparasitic; General characteristics of antimicrobial drugs (active form-pharmacodynamic design, pharmacodynamic properties, selective toxicity, therapeutic index, range of effectiveness-narrow/ broad, Cidal/ Static effects, MIC, and MLC).
- b) Burden of antibiotic resistance, Surveillance of antibiotic resistance, example (through online resources for mapping antibiotic resistance website) Resistance Map developed by the Center for Disease Dynamics, Economics & Policy (CDDEP) and data visualization uses data from the ECDC.

UNIT- II ANTIMICROBIALS AND ANTIMICROBIAL ACTION

- a) Antibacterial agents - modes of action with one example each: inhibitors of cell wall synthesis, inhibitors of cell membrane function, inhibitors of protein synthesis, inhibitors of nucleic acid synthesis, inhibitors of metabolic process.
- b) Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine.

UNIT- III ANTIMICROBIAL RESISTANCE

- a) Antimicrobial resistance - Definition of drug resistance, cross resistance, MDR, XDR and pandrug resistance, MRSA, NDM-1, superbug. Factors contributing for the development of resistance, emergence and spread of antimicrobial resistance -environment mediated (within healthcare, between people, international travel, animals to humans and from humans to animals, food, water) and microorganism mediated -intrinsic and acquired), overview of pathways for antimicrobial resistance.

- b) Antimicrobial susceptibility testing: Standards and limitations for AST, Conventional Methods: disk diffusion, agar dilution, broth dilution-and media used, interpretation of results (susceptible, intermediate, or resistant, with recently added categories of no susceptible and susceptible dose-dependent, breakpoints, epidemiologic cutoff value (ECV) CLSI, EUCAST.
- c) Testing categories: Routine test, supplemental (non-routine) test, Screening test, Surrogate agent test, equivalent agent test with example. Commercial Susceptibility Testing Systems: gradient strip, Automated Antimicrobial Susceptibility Test Systems VITEK, MicroScan. Advanced methods: PCR, Microarrays, MALDI-TOF, whole genome sequencing.

UNIT- IV MANAGEMENT OF ANTIMICROBIAL RESISTANCE

- a) Events of discovery of new antibiotic classes and void, Usage of antibiotics, sources of antibiotic resistance; Prevention and Control: One Health approach, Alternatives to Antimicrobials - (Antibodies, probiotics, phage treatment, vaccination, antimicrobial peptides, RNA interference) pros and cons.
- b) Future perspectives to control antibiotic resistance: judicious antibiotic usage, awareness programmes.

References:

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6. Procop GW and Koneman EW. Koneman's Color Atlas and Textbook of Diagnostic Microbiology. 7th Edition, Wolters Kluwer.
7. Tille M.P, Bailey & Scott's. Diagnostic Microbiology. 13th Edition. Elsevier
8. Clinical Laboratory Standards Institute, M100 Performance standard for Antimicrobial Susceptibility Testing, 31st edition.
9. <https://resistancemap.cddep.org/>

SEC 05: Professional and Societal communication

L	T	P	C
3	0	0	3

Curriculum awaited from GOK

Semester Seven

DSC 15 – VIROLOGY & PARASITOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Enables to understand modern virology including areas of virus biology, pathogenesis and disease control
- Introduces the advanced concepts of parasitology and host-parasite relationship
- Gives a broad perception of epidemiology of virus and parasitic diseases

Course Outcomes: At the end of the course, learners will be able to

1. **Understand** the basic concepts in the field of virology and apply these concepts to problems in the field of virology
2. **Describe** the viral diseases and their etiology.
3. **Understand** and **explain** the concept of parasitism and apply the same in various human and veterinary parasite control and treatment.
4. **Describe** the parasitic diseases and their etiology.

THEORY

UNIT -I INTRODUCTION TO VIROLOGY

- a) History, Brief outline on discovery of Viruses, Distinctive properties of Viruses; Morphology & ultrastructure (Capsid Symmetry, Helical Capsids, Icosahedral Capsids, Enveloped and Non enveloped Viruses, Complex Virus Structures, Protein–Nucleic Acid Interactions, and Virus Receptors). Nomenclature and classification of Viruses.
- b) **Viral Genetics:** Lytic and Lysogenic cycles, Phage Phenotypes, Phenotypic Mixing, Recombination in viruses: Mutations, Recombination and Mapping. Bacteriophage, Bacteriophage typing, application in bacterial genetics.
- c) Sub-viral agents (Satellites and Viroids, Prions), New and Emerging Viruses.

UNIT -II TYPE STUDY OF VIRUSES

- a) Types of viruses: Epidemiology, life cycle, pathogenicity, diagnosis, prevention, and management of diseases - DNA Viruses- Pox viruses (varicella zoster), Herpes viruses (Herpes Simplex 1 and 2), Hepatitis viruses (HBV).
- b) RNA Viruses- Picorna (Polio), Orthomyxo (Influenza), Paramyxo (Measles morbilli, Rubella measles), Toga virus (Rubella) Flavivirus (Dengue), Corona virus (SARS-CoV- 2), Rhabdo virus (Rabies virus), Retrovirus (HIV), oncogenic viruses (HPV).
- c) Viruses of cyano-bacteria, algae, fungi, plants (TMV and CMV) and insects.

UNIT -III INTRODUCTION TO PARASITOLOGY

- a) Introduction and Classification of Parasites
- b) Epidemiology, life cycle, pathogenicity, diagnosis, prevention, and management of diseases: Intestinal amoebae - *Entamoeba histolytica*, Free living amoebae – *Naegleria fowleri*, Intestinal

and genital flagellates – *Giardia lamblia*, *Trichomonas vaginalis*. Blood and tissue flagellates – *Leishmania donovani* and *Trypanosome cruzi*, Malarial parasites – *Plasmodium*, Coccidian – *Toxoplasma gondii*.

c) Laboratory techniques in parasitology - Examination of feces - Direct and concentration methods.

UNIT- IV TYPE STUDY OF PARASITES

- a) Study of Helminthes: Epidemiology, life cycle, pathogenicity, diagnosis, prevention, and management of diseases- *Taenia solium*, *Schistosomes*, *Ascaris lumbricoids*, *Trichuris*, and *Wuchereria bancrofti*.
- b) Blood smear examination, cultivation of protozoan parasites, serology, and PCR techniques.

PRACTICAL 15: VIROLOGY & PARASITOLOGY

1. Isolation of coliphages from sewage (Plaque assay for bacteriophage)
2. Enumeration of bacteriophage in a sample by plaque forming unit (PFU method)
3. Isolation and identification of protozoa from sewage
4. Preparation of smear and identification of blood parasites (preparation of stains and ready slides (Leishmania, Trypanosome and Plasmodium))

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DSC 16 – BACTERIA AND ARCHAEA

L	T	P	C
3	0	2	5

Course Objectives: The course

- Introduces a broad view of bacterial molecular systematics and archaeal groups.
- Discusses the different disease-causing bacterial pathogens and applications of archaeobacteria.

Course Outcomes: At the end of the course, the learners will be able to

1. **Understand** systematics and general characteristics of bacteria.
2. **Identify** different disease-causing bacterial pathogens.
3. **Discuss** the characteristics and different groups of archaea.
4. **Differentiate** between archaea and bacteria genomic organization.

THEORY

UNIT-I AN OVERVIEW OF BACTERIA

- a) General discussion on the occurrence, diversity, characteristic features, and significance. Conventional and molecular systematics.
- b) Recent trends in Microbial Taxonomy: Molecular method: DNA homology, DNA- RNA homology, G + C ratio, rRNA sequencing; Genetic methods and Serological methods in taxonomy; Taxonomy based on ecology.
- c) A brief account on general characteristics, classification, diversity, distribution & economic importance of Actinomycetes, Cyanobacteria, Bioluminescent bacteria; Mechanism of bioluminescence and its applications.
- d) Bacterial Genetics: Bacterial Transformation: Types of transformation mechanisms found in prokaryotes, Bacterial Conjugation: properties of the F plasmid, F+ x F - mating, F' x F- conjugation, Hfr conjugation. Transduction: Generalized and specialized transduction, Transposable elements.

UNIT- II MEDICAL BACTERIOLOGY

- a) Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis, prevention, and control: Staphylococci, Neisseriae (Gonococci & Meningococci), Corynebacterium, Mycobacterium, and Clostridium.
- b) Studies on Salmonella, Shigella, Vibrios; Gram Negative anaerobes – Spirochetes, Rickettsiae, Chlamydiae, Mycoplasmas and Uredoplasma.
- c) Bacterial Zoonotic diseases (Anthrax and Brucellosis) and their control; Hospital acquired infections, Hospital waste disposal.

UNIT- III AN OVERVIEW OF ARCHAEA

- a) General Characteristics of Classification, Role of Archaeobacteria in the evolution of Microbial world.
- b) Cellular organization: cell morphotypes, cell envelopes -archaeal membrane lipids and cell wall, appendages -pili, flagella, cannulae, hami.
- c) Nutrition, growth and growth kinetics and physiological versatility, genera belonging to Nanoarchaeota (*Nanoarchaeum*); Crenarchaeota (*Sulfolobus*; *Thermoproteus*) Methanogens (*Methanobacterium thermoautotrophicum*); Halophiles (*H. salinarum*); Thermophiles (*Thermoplasma acidophilum*); Thermoacidophiles (*Sulfolobus acidocaldarius*); Psychrophilic archaea (*Methanogenium frigidum*, *Methanococcoides burtonii*); Methanotrophs.

UNIT- IV GENOME ORGANIZATION IN ARCHAEA

- a) Genome structure, Size of genome, G + C content, associated proteins, archaeal histones and nucleosomes, introns in archaea, archaeal RNA polymerases, reverse DNA gyrase.
- b) Plasmids, transposons -IS elements. Modifications in tRNA and rRNA structure. Novel 7S rRNA. DNA replication, translation, and transcription in archaea.
- c) Applications of archaeobacteria in various fields.

PRACTICAL 16: BACTERIA AND ARCHAEA

1. Isolation of bacteria from soil and water.
2. Identification of bacteria- Colony morphology, staining and biochemical characteristics.
3. Study of bacterial growth curve and determination of growth rate of *E. coli*.
4. Endospore formation and staining in *Bacillus spp.*
5. Capsule staining in bacteria.
6. Antimicrobial sensitivity test and demonstration of drug resistance.
7. Determination of minimum inhibitory concentrations (MICs) of antimicrobial agents.

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DSC 17 – MYCOLOGY & PHYCOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Introduces to the concept of mycology including classification, structure, life cycle, genetic, growth, nutrition and economic importance of fungi
- Outlines the classification and general overview and ecology of algae
- Imparts knowledge of the beneficial and harmful effects of algae, their economic importance, and applications in various fields

Course Outcomes: At the end of the course, learners will be able to

1. **Understand** the role of fungi in ecology and its economic importance.
2. **Explain** the significance of fungi in human health and diseases.
3. **Classify** algae based on their characteristics, ecology and classification.
4. **Understand** and **analyze** thallus organization, reproduction and life cycles of different groups of algae.

THEORY

UNIT- I INTRODUCTION TO MYCOLOGY

- a) History and development of Mycology, General characteristics of fungi : Morphology and somatic structures (thallus , organization, fungal cell, nuclear components, specialized somatic structures; Aggregation of hyphae, tissues, mycangia); fungal nutrition and reproduction (Asexual, Sexual reproduction, Heterothalism and Parasexuality) Taxonomy, Classification of fungi. Fungal Associations: Lichens – ascolichens, basidiolichens, deuterolichens; Mycorrhiza – ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza. Fungi as insect symbiont.
- b) Salient features: Myxomycota, Phycomycota, Plasmodiophoromycota, Hypochytriomycota, Labyrinthulomycota, Oomycota, Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Deuteromycota.
- c) Economic importance of fungi: Importance of fungi in agriculture, industry and medicine. Fungi as biocontrol agent, Fungi as SCP, Fungi as parasites of human and plants. Role of fungi in biodeterioration of wood and paper. Note on mycotoxins.

UNIT- II CLINICAL MYCOLOGY

- a) Clinical classification of fungi- Superficial, subcutaneous, systemic and opportunistic mycoses; pathogenesis and spectrum of diseases. Immunity to fungal infections. Note on mycotoxins.
- b) General characteristics, epidemiology and pathogenesis, spectrum of disease of mucorales (*Mucor*), dermatophytes (*Trichophyton*), systemic (*Candida*), superficial (*Tinea sp*) and opportunistic mycoses (*Aspergillus*).

- c) Fungal Genetics: *Neurospora*- Tetrad analysis and linkage detection - 2 point and 3 point crosses, chromatid and chiasma interference, Mitotic recombination in *Neurospora* and *Aspergillus*.
- d) Diagnostic Mycology: Lab diagnosis- Collection, transport and culturing of clinical specimens; Culture media and incubation. Direct microscopic observation, serologic testing, molecular methods and MALDI TOF; Antifungal agents - testing methods.

UNIT -III CLASSIFICATION AND ECOLOGY OF ALGAE

- a) History, classification, and ecology of algae: Definition, General characteristics, phases of development of phycology, scope of modern phycology, Classification of algae: Types of classification, Fritsch's classification.
- b) Habitat, diversity, Phytoplankton, marine epilithic, freshwater and soil algae. Algal ecology at extreme temperatures, ecology of algae in symbiotic associations.
- c) Algal Genetics: *Chlamydomonas*- unordered tetrad analysis - Recombination and Mapping, Nucleocytoplasmic interactions and gene expression in *Acetabularia*. Extra nuclear (cytoplasmic) inheritance.

UNIT- IV TYPE STUDY AND ECONOMIC IMPORTANCE

- a) Type study and Culturing of algae: General thallus organization, reproduction types and life cycles in algae, type study of Chlorophyceae (*Chlamydomonas*), Xanthophyceae (*Vaucheria*), Bacillariophyceae (Diatoms), Pheophyceae (*Sargassum*), Rhodophyceae (*Gracilaria*), Myxophyceae (*Anabaena*).
- b) Laboratory and commercial cultivation of algae: Different kinds of algal cultures, isolation of algal cultures, Culture media for algae, laboratory culturing of algae, importance of laboratory culture.
- c) Economic importance: Harmful and beneficial aspects of algae, Algae as primary source of food and energy (single cell protein and biofuels). Applications in the field of agriculture, bioremediation, pharmaceuticals, cosmetics, sewage and research.

PRACTICAL 17: MYCOLOGY & PHYCOLOGY

1. Isolation of fungi from rhizosphere.
2. Isolation of aquatic fungi by baiting technique.
3. Direct examination of infected tissues (skin/nail/hair) for dermatophytes.
4. Isolation of yeast from different sources
5. Enumeration of fungal spores/ cells by Haemocytometer
6. Study of the following representative genera: *Neurospora*, *Polyporus*, *Puccinia*, *Alternaria*, *Drechslera*, *Saprolegnia*, *Mucor* *Trichoderma* and symbiotic fungi- Lichens.
7. Isolation and identification of cyanobacteria from soil
8. Isolation and identification of cyanobacteria from freshwater
9. Study of the following representative genera: *Chlamydomonas*, *Vaucheria*, *Sargassum*, *Diatoms*, *Gracilaria*, *Anabaena*.

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DSE 03a – PRINCIPLES OF STATISTICS

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Provides knowledge about both theoretical and practical aspects of statistics, to bring them in contact with basic concepts and methods in Statistics.
- Emphasizes on a problem-solving attitude with the aid of statistical methodology.

Course Outcomes: At the end of the course, learners will be able to

- **Explain** and construct the frequency distribution and graphical methods.
- **Describe** the types of probability and apply it in statistical methods.
- **Analyze** sampling methods and understand the concept of population.
- **Perform** Test of Hypothesis and understand the concept of p-values

THEORY

UNIT- I DESCRIPTIVE STATISTICS

- a. Importance and Scope of Statistics, Data Types, Variables, Frequency Distribution, Graphical Representation Methods (Histogram, Bar Charts, Pie Charts), Measures of Center Tendency (Mean, Median, Mode,) and Dispersion (Standard Deviation, Variance) Advantages and Disadvantages.

UNIT- II PROBABILITY

- a) Basic Terminology: Trial, Events, Sample Space and Sample Points, Basic Laws of Probability, Types of Probability, Normal probability curve, Standard Normal Distribution, Bayes theorem -simple problems.

UNIT- III SAMPLING METHODS

- a) Concept of Population, Sample, Sampling, Sample Size, Sampling Error, Advantages and Disadvantages of Sampling Method, Types of Random Sampling Methods – SRS, Stratified Random Sampling, Systematic Random Sampling and Cluster Sampling.

UNIT- IV TESTING OF HYPOTHESES

- b) Statistical Hypotheses-Null and Alternative, Level of Significance, Type I and Type II Error, P Value, Degrees of Freedom, Chi-Square Test, Student's t Test: One Sample t - Test and Paired and unpaired t-Test, Analysis of Variance. Correlation-Karl Pearson's and Spearman's rank correlation. Regression Analysis.

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DSE 03b RESEARCH METHODOLOGY

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Provides knowledge on research methodology, types of research and formulation and designing of research problem.
- Emphasizes on ethical issues in research and provides knowledge on scientific writing.

Course Outcomes: At the end of the course, learners will be able to

- **Explain** the types of research and formulate a research problem.
- **Describe** the basic principles of experimental design types and tools for data collection.
- **Understand** the overview and research misconduct and ethical issues in research.
- **Discuss** and **understand** the significance of scientific writing and concept of interpretation.

THEORY

UNIT -I RESEARCH FORMULATION

- a) Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research.
- b) Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT – II RESEARCH DESIGN

- a) Meaning, Need, Features of Good Design, Concepts, Types. Basic principles of Experimental Design, various methods of Research. Survey, Philosophical, Historical, Experimental, Causal Comparative, Genetic, Case Studies.
- b) Tools for Data Collection: Collections of Primary Data, Collection of Data through questionnaire and Schedules, other Observation Interview Methods, Collection of Secondary Data, Selection of appropriate method for data collection, Case Study, Focus Group Discussion, Techniques of developing research tools, viz. Questionnaire and rating scales etc. Reliability and validity of Research tools.
- c) Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT- III ETHICAL ISSUES IN RESEARCH

- a) Introduction, overview and research misconduct, rules and regulations in India, data management, mentoring, mentor - mentee responsibilities, authorship guidelines,

publication and peer review, intellectual property, plagiarism, patents, collaboration, reporting and representation research, representing images.

- b) Bias, conflicts of interest, ethical use of animal subjects, protection of human subjects, stem cell ethics, Eco sourcing code of practice, radioactive, chemical and biohazard safety, waste management and disposal, social responsibility.

UNIT – IV SCIENTIFIC WRITING

- a) Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation.
- b) Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

REFERENCES

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
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Semester Eight

DSC 18 – MICROBIAL ENZYMOLOGY AND PHYSIOLOGY

L	T	P	C
3	0	2	5

Course Objectives: The course

- Provides the knowledge about enzymes and their basic working principles, concepts of immobilization technologies, biosensors and their applications and apply the knowledge of enzyme purification and characterization in research and industry.
- Enables to understand the importance of metabolism & Physiology in Microbial Growth

Course Outcomes: At the end of the course, the learners will be able to

1. **Understand** and **apply** the concepts and principles of enzymology
2. **Explain** the structure and function of enzymes, kinetics, and regulation mechanisms
3. **Analyze** and **apply** concepts of enzyme applications and technologies in various fields including industry, medicine etc.
4. **Understand** the importance of enzyme immobilization and biosensors

THEORY

UNIT-I BASIC CONCEPTS AND ENZYME KINETICS

- a) Fundamental concepts of Bioenergetics; principles of catalysis – collision theory, transition state theory. Definition, Structure, Classification and Properties of enzymes; Mechanism of Enzyme actions: Lock and Key model, induced fit Theory; concept of active site; energetics of enzyme substrate complex formation; Factors affecting rates of enzyme mediated reactions (pH, temperature, substrate and enzyme concentration).
- b) Kinetics of single substrate reactions: Michelis – Menten equation, Km and Vmax, multisubstrate reactions; turnover number. Enzyme inhibition - competitive, non-competitive, uncompetitive, mixed inhibition; double reciprocal plot; Enzyme regulation.

UNIT -II PURIFICATION, CHARACTERIZATION AND APPLICATION OF ENZYMES

- a) Production and purification of crude enzyme extracts from plant, animal and microbial sources: ammonium sulphate precipitation, dialysis and chromatographic techniques (gel filtration, ion-exchange, affinity, Hydrophobic interaction chromatography, HPLC); polyacrylamide gel electrophoresis (SDS-PAGE).

- b) Methods of characterization of enzymes (temperature, pH, kinetic constants, substrate specificity, determination of molecular weight, effect of metal ions, chelating and denaturing agents, and isoelectric point). Enzymatic assays – Enzyme activity and specific activity concept, Continuous and discontinuous assays.

UNIT III: MICROBIAL PHYSIOLOGY

- a) Microbial Energetics, Basic aspects of bioenergetics, entropy, enthalpy, electron carriers, artificial electron donors, inhibitors, uncouplers, energy bond, phosphorylation.
- b) Microbial Photosynthesis: Photosynthetic Pigments and apparatus in bacteria. Oxygenic and Anoxygenic Photosynthesis. Autotrophic CO₂ fixation and mechanism of Photosynthesis. Utilization of light energy by Halobacteria.
- c) Autotrophic Mechanisms in bacteria: Hydrogen bacteria, Nitrifying bacteria, Purple sulfur bacteria, Non-sulfur bacteria, Green sulfur bacteria, Iron bacteria, Methylobacteria; Microbial Stress Responses: Oxidative stress, Thermal stress, Starvation stress, Aerobic to anaerobic transitions. Biofilm and quorum sensing.

UNIT IV: MICROBIAL METABOLISM

- a) Nucleic acid metabolism: Biosynthesis and degradation of purines and pyrimidines.
- b) Carbohydrate metabolism Glycolysis, Citric acid Cycle and different types of Phosphorylation, Fates of pyruvate, Fermentation. Utilization of sugars other than glucose: Lactose, Galactose, Maltose, Mannitol. Degradation of cellulose, Starch and Glycogen.

PRACTICAL 18: MICROBIAL ENZYMOLOGY AND PHYSIOLOGY

1. Preparations of solutions and buffers, pH adjustment using pH meter
2. Qualitative screening of microorganisms for Invertase production
3. Qualitative screening of microorganisms for Amylase production
4. Qualitative screening of microorganisms for Lipase production
5. Determination of enzyme activity: Catalase, invertase and amylase.
6. Determination of K_m and V_{max}
7. Demonstration of protein purification by ammonium sulphate
8. Demonstration of SDS PAGE

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DSC 19 – SOIL MICROBIOLOGY & PLANT HEALTH

L	T	P	C
3	0	2	5

Course Objectives: The course

- Introduces the fundamental concepts of plant disease, differences between symptom, sign, infectious and non-infectious diseases.
- Enables to understand the importance of plant disease control for economic and environmental sustainability and to obtain healthy crops; to reduce infectious disease in plants and about the concept of integrated disease management.

Course Outcome: At the end of the course, learners will be able to,

1. **Explain** the structure of soil and interactions among microorganisms
2. **Describe** host pathogen interaction and defense mechanism
3. **Identify** disease symptoms, major infective crop diseases and their economic impact
4. **Interpret** the principle of disease control and integrated disease management.

UNIT- I SOIL MICROBIOLOGY

- a) Characteristics and classification of soil: physical, chemical and biological, soil profile and soil formation. Interaction of microbes with plants (positive and negative interactions): Rhizosphere, phyllosphere, mycorrhizae.
- b) Nitrogen cycle, Symbiotic and Asymbiotic Nitrogen Fixation – mechanism and genetics of Nitrogen Fixation.

UNIT- II PLANT PATHOLOGY

- a) Plant pathogens and classification of plant diseases. Host-pathogen recognition and specificity. Principles of plant infection and defense mechanisms - entry of pathogen in to host, colonization of host, role of enzymes, toxins and growth regulatory substances.
- b) Defense mechanisms in plants – Structural, biochemical, and molecular aspects of host defense reactions.

UNIT -III PLANT DISEASES

- a) Plant pathogens type study - Study of the following diseases (Epidemiology, life cycle, pathogenicity, diagnosis, prevention and management of): Tobacco mosaic, Bacterial blight of paddy, Blast of Paddy, Red rot of sugarcane, Citrus canker, Leaf spot of mulberry, Sandal Spike, Root knot of mulberry, Tikka disease of Groundnut, Downey mildew and powdery mildew of grapes, Bunchy top of Banana, Fusarium wilt of Banana.

UNIT- IV EPIDEMIOLOGY AND MANAGEMENT OF PLANT DISEASES

- a) Methods used in plant-disease forecasting (weather-based predictions, inoculum-based predictions and host physiology based predictions).
- b) Cultural and chemical methods for exclusion, eradication of pests and pathogens for protection of plants (Crop rotation, tillage, fertilization, irrigation, selection of the cultivar(s) and site of cultivation, plant and soil management, pruning, phytosanitation, seed treatment). Breeding for disease resistance and application of integrated methods of plant disease control.

PRACTICAL 19: SOIL MICROBIOLOGY & PLANT HEALTH

1. Study of associated soil microbes with plants: Actinorhiza and Mycorrhiza
2. Isolation of phosphate solubilizing microbes from soil
3. Isolation of *Fusarium* from wilt diseases.
4. Demonstration of Koch's postulates for a bacterial pathogen/fungal pathogen.
5. Effect of seed-borne pathogens on seed germination and seedling vigour.
6. Fungicide evaluation by spore germination inhibition assay.
7. Fungicide evaluation by agar diffusion inhibition assay.
8. Demonstration of antagonism by dual culture plate technique.

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DSE 04a – MICROBIAL NANOTECHNOLOGY

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Provides the knowledge on the basic understanding of nanotechnology in the field of Microbiology
- Enables to understand the applications of Nanomedicines in the field of diagnostics, and health care products

Course Outcomes: At the end of the course, the learners will be able to

1. **Describe** properties, characteristics, and types of nanoparticles.
2. **Demonstrate** techniques used for synthesis of nanoparticles.
3. **Discuss** the types, preparation methods and application of bionanomaterials.
4. **Explain** the applications of nanotechnology in the field of biology and medicine

THEORY

UNIT- I INTRODUCTION TO NANOTECHNOLOGY

- a) Physical and chemical properties of nanoparticles, nanoclusters, nanocomposite, nanotubes and nanowires.
- b) Characterization of nanoparticles – UV- Vis spectroscopy, Electron Microscopy – HRTEM, SEM, AFM.
- c) Application of Scanning probe microscopy in biology and medicine.

UNIT- II SYNTHESIS OF NANOPARTICLES

- a) Biological Synthesis of Nanoparticles and nano biomaterials - Microbial synthesis of Nanoparticles.
- b) Synthesis of nanodrugs – metal nanoparticles, Nano shells –dendrimers, Nanoparticle drug systems.

UNIT- III PREPARATION OF NANO-BIOMATERIALS

- a) Nanoparticles – types, functions and application of Silver, Gold, Zinc oxide and Titanium.
- b) Polymeric scaffolds, Mucopolysaccharides, proteoglycans, cellulose and derivatives; Dextrans; Alginates; Pectins; Chitin.

UNIT- IV APPLICATIONS IN BIOLOGY AND MEDICINE

- a) Nanotechnologies for biology and medicine - Micro- and nano- fluidics.

- b) Self-assembly of biological molecules. Drug delivery – protein mediated, and nanoparticle mediated. Hybrid-conjugates of gold nanoparticles – DNA origami.
- c) Nanoparticles as carrier for genetic material and Nanosensors, Nanotechnology for Point-of-Care diagnostics and nano diagnostics in infectious diseases.

REFERENCES

1. Boisseau P, Houdy P and Lahmani M. (2010). Nanoscience: Nanobiotechnology and Nanobiology, Springer, New York.
2. Nalwa HS. (2005). Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publishers.
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DSE 04b – INDUSTRIAL TRAINING & ENTREPRENEURSHIP

L	T	P	C
3	0	0	3

Objectives: The course

- Emphasizes on principles and concepts of entrepreneurship, its historical development, and the importance of entrepreneurship in economic development.
- Enables to effectively apply the theories and various approaches of entrepreneurship.

Course Outcomes: At the end of the course, the learners will be able to,

1. **Appreciate** the importance of entrepreneurship and value the characteristics of successful entrepreneur.
2. **Identify** business opportunities in chosen sector / sub-sector and plan and market and sell products / services.
3. **Develop** a small business enterprise by liaising with different stake holders.
4. **Implement** business ethics and **operate** small scale enterprises.

THEORY

UNIT -I FUNDAMENTALS OF ENTREPRENEURSHIP

- a) Meaning, definition of Entrepreneur, Enterprise, Entrepreneurship, Characteristics of successful entrepreneur and Functions.
- b) Role of entrepreneur in economic development, women entrepreneur, Rural entrepreneur, Agricultural entrepreneur-meaning, and challenges.

UNIT- II ENTREPRENEURSHIP DEVELOPMENT PROGRAM AND FINANCING OF SMALL BUSINESS

- a) Meaning, objective, importance, institutions doing EDP in India, DIC, CEDOCK, SSI, NSIC, EDII, AWAKE, KVIC, RUDSET, Industrial Estate-Meaning and importance.
- b) Financing of small business in India, institutional and non-institutional assistance-SFCs, banks, SIDBI, NBFC-meaning and schemes; venture capital, bills discounting, factoring, state and central government subsidies and incentives for SSI (existing)-recent industrial policy(2011), PM MUDRA yojana- meaning, objectives, procedures for obtaining loan under MUDRA.

UNIT -III SETTING UP OF NEW BUSINESS

- a) Forms for small business- small proprietorship, partnership, private company, cooperative society-meaning and nature, project formulation, project report-meaning, importance, general format of project report, project appraisal financial, technical marketing, social feasibility study, obtaining license, clearance certificate, registration procedure.
- b) Ideas to start new business, criteria for selection of new product or service, Market Survey as a tool, Technical and economic feasibility of a project, Role of consultancy organizations, Project formulation and project report preparation

UNIT -IV BUSINESS ETHICS, MARKETING AND HUMAN RESOURCE ASPECTS

- a) Ethics in business: importance, various social responsibility of an entrepreneur towards customers, suppliers, government and society, self-employment; recent trends in the areas of self-employment.

- b) Marketing Aspects: Meaning, scope and importance, Marketing strategy, Market segmentation, marketing channels; Digital marketing through Web browsing, Face book, Google search engines, SMS campaigns, Mailers, Hand bills etc
- c) Human Resource Aspects: H.R Policies, Concept and scope in modern industry, Different modes of employment, Placement of proper person for a job, Interpersonal relations and communication skills, training of personnel, guidance for stress management, soft skills.

REFERENCES:

1. Gupta C B and Srinivasan N.P. (2020). Entrepreneurship Development. Revised Edition. Sultan Chand & Sons.
2. Khanka S S. (2020). Entrepreneurial Development. Reprint edition. S Chand and company limited.
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05a - RESEARCH PROJECT OR

DSE 05b – EXTREMOPHILIC MICROBIOLOGY

L	T	P	C
3	0	0	3

Course Objectives: The course

- Provides the knowledge about microorganisms in extreme environments and their potential applications
- Imparts the knowledge about microbes in toxic environments and their adaptation in space environments.

Course Outcomes: At the end of the course, the learners will be able to

1. **Describe** extremophiles and conventional microbes in extreme environments
2. **Explain** the Physiology and adaptation strategies of extremophiles
3. **Discuss** microbes in toxic environments through case studies
4. **Explain** the types of microorganisms in Space and their application in antibiotic and food production.

THEORY

UNIT- I EXTREMOPHILES AND CONVENTIONAL MICROORGANISMS

- a) Concept of extremophiles v/s conventional microbial forms & archaea: habitats in universe, eco-niches, communities and community associations, biofilms.
- b) Microbial community analysis of extreme environments using molecular approaches (DGGE, cloning and next generation sequencing, functional genomics and transcriptomics).

UNIT- II PHYSIOLOGY AND APPLICATION OF EXTREMOPHILES

Occurrence, physiological features, adaptation strategies of various extremophilic microbes:

- a) Ancarobes, barophiles/ peizophiles, cryophiles & thermophiles; oligotrophs, osmophiles, halophiles & xerophiles; radiophiles, metallophiles & xenobiotic utilizers; alkaliphiles/ basophiles and acidophiles.
- b) Potential applications of extremophilic microorganisms.

UNIT- III MICROBES IN TOXIC ENVIRONMENTS

- a) Acid mine drainage, waste containing cyanides, xenobiotics, pesticides, heavy metals and radio isotopic materials, extremozymes and their applications.
- b) Field and case studies.

UNIT- IV SPACE MICROBIOLOGY

- a) Historical development of space microbiology, Life detection methods- Evidence of metabolism (Gulliver) and Evidence of photosynthesis (autotrophic and heterotrophic).
- b) Antibiotic production from space, food production by bacteria in outer space, benefits of the microbial observatory program in outer space, Future directions in space microbiology.

REFERENCES

1. Brock, T. D. Thermophilic microorganisms and life at high temperatures, Springer, New York
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DSE 05c – SYSTEM & SYNTHETIC MICROBIOLOGY

L	T	P	C
3	0	0	3

Course Objectives: The Course

- Provides the fundamental knowledge of the basic principles of system microbiology through different biological system such as genomics, transcriptomics, metabolomics, and proteomics.
- Imparts knowledge on re-design of natural biological system or design new biological system for useful purposes.

Course Outcomes: At the end of the course, learners will be able to

1. **Describe** the concepts of Omics in microbiology and understand the next generation sequencing.
2. **Explain** genomic structure and organization in microbial communities.
3. **Discuss** various microbial genomic tools and their applications.
4. **Understand** the concept of synthetic microbiology and its use in medical, industry, and in agriculture sectors.

THEORY

UNIT- I BASIC INTRODUCTION OF SYSTEM MICROBIOLOGY

- b) An overview of “Omics” concepts such as genomics, transcriptomics (RNA-Seq), proteomics, metabolomics, and metagenomics.
- c) Basics of next-generation sequencing (NGS) methods and high throughput techniques used in proteomics and metabolomics; Impacts and applications of NGS and techniques in food-microbiology, industrial microbiology and public health microbiology.

UNIT -II MICROBIAL GENOMICS

- a) An overview of Microbial Genomics; Microbial Genome Structure and organization; Genomics of cultured and uncultured microbial communities.
- b) Principles of microbial genome assembly, annotation of microbial genomes.

UNIT III APPLICATIONS OF MICROBIAL GENOMIC TOOLS

- a) Use and application of various bioinformatics databases and tools in Microbial Genomics, Search and retrieval of biological information and databases sequence for Microbial Genomics.
- b) Applications of microbial genomics in vaccine and drug designing, agriculture, and in food microbiology.

UNIT – IV SYNTHETIC MICROBIOLOGY

- a) An introduction of synthetic microbiology, Basic principles, methods, and tools for engineering microbes; Genome editing tools and techniques such as CRISPR/Cas9 used to synthetic bacteria.
- b) Development of engineered microbes for disease diagnostics, therapeutics, and human pathogens; Synthetic and Designer probiotics; Applications of engineered bacteria in vaccine designing, drug delivery, and in industry; Biosafety and biosecurity issues.

REFERENCES:

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4. Colin Harwood and Anil Wipat (2013) Microbial Synthetic Biology. Academic Press

DSE 05d – MICROBIOME & HEALTH

L	T	P	C
3	0	0	3

Course objectives: The course

- Familiarizes the students with the concept of microbiome, its composition at different sites, role in health and disease along with the various tools and techniques used for its analysis.
- Discusses the strategies to correct the microbiome and its impact on health and well-being.

Course outcomes: At the end of the course, the learners will be able to

1. **Understand** the basic concepts of human microbiome and summarize the tools and methods of studying the microbiome.
2. **Examine** the role and functions of host-associated microbiomes in health and disease
3. **Assess** the potential of probiotics, prebiotics and fecal microbial transplantation in maintaining health.
4. **Develop** scientific literacy to **understand** current news on microbiome advances, value of natural birth and natural exposures, and impacts of modern lifestyle.

○ THEORY

UNIT -I MICROBIOME AND DATA ANALYSIS

- a) Introduction to human microbiota and microbiome (bacteriome, mycome, virome), composition at various sites, sources.
- b) Methods for microbiome analysis: i) DNA-based analysis of microbial communities, 16S rRNA gene amplicon sequencing and shotgun metagenomics sequencing methods; ii) Functional genomic analysis, meta transcriptome, metabolome, proteome, and glycome.
- c) Microbiome data analysis: assignment of taxonomy, microbiome complexity (alpha and beta diversity), phylogenetic trees, Venn diagrams, and heat maps.

UNIT- II GUT MICROBIOME

- a) Gut ecology: Basic structure and features of the gut, gut microbiota and its composition, acquisition of microbiome during birth and growth; role of microbiota in gut homeostasis; gut microbiota and immune system crosstalk; and gut-brain axis.
- b) Factors affecting gut microbial balance, dysbiosis and disease development; microbial metabolites affecting health (antimicrobial peptides, short chain fatty acids).

UNIT -III SITE SPECIFIC MICROBIOMES

- a) Microbiota of oral cavity, respiratory tract and lungs, gut-lung axis, role of microbiota in COPD.
- b) Skin microbiome (composition, role in dermatitis, immunodeficiency, and wound infections).

- c) Vaginal (composition, role in bacterial vaginosis, sexually transmitted disease and pregnancy outcomes), brief account of placental microbiome.

UNIT- IV MICROBIOTA RESTORATION

- a) Prebiotics: concept, definition, criteria, sources, and types (FOS, GOS, XOS, Inulin, fructans, lactulose, breast milk oligosaccharides, Resistant starch), role in maintaining gut microbiota and health, production of prebiotics
- b) Probiotics: Introduction, history & definition, probiotic microorganisms (Lactic acid bacteria, Bifidobacteria, *Bacillus*, *Saccharomyces*), next generation probiotics; safety and legal status of probiotics; Probiotic selection and characterization: criteria and WHO/ICMR guidelines; Mechanism of probiotic action; health benefits and application of probiotics.
- c) Fecal microbiota transplantation: concept, application in disease, ethics, and future perspectives

REFERENCES

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DSE 05e – VACCINE TECHNOLOGY

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Course Objectives: The Course

- Provides the knowledge on conventional to recent technology of vaccine production.
- Imparts knowledge on the types of vaccines, its immunological effects and regulatory guidelines.

Course Outcomes: At the end of the course, the learners will be able to

1. **Explain** the fundamentals and classification of vaccines and understand developing an innovative vaccine technology with different mode of vaccine delivery.
2. **Describe** the significance of critical antigens, immunogens, and adjuvants in developing effective vaccines.
3. **Describe** the fundamentals of immune recognition and understand the process of vaccine design and development.
4. **Understand** the regulatory issues, guidelines for the management of production of vaccine.

THEORY

UNIT-I VACCINE TECHNOLOGY

- d) Fundamentals of vaccine technology, History, and development. Classification of Vaccines and its Preparations.
- e) Types of Immunization: Active and passive immunization; Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, subunit vaccines.

UNIT- II VACCINE PREPARATION & TYPES

Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, edible vaccines, reverse vaccinology, combination vaccines, therapeutic vaccines; Peptide vaccines, conjugate vaccines; Cell based vaccines.

UNIT- III VACCINE RESEARCH AND DESIGN

- a) Fundamental research to rational vaccine design. Antigen identification and delivery, T- Cell expression cloning for identification of vaccine targets for intracellular pathogens, Fundamentals of Immune recognition, implications for manipulating the T-Cell repertoire, Targeting Dendritic cells
- b) A rational approach for Vaccine development, Cellular basis of T- Cell memory, Rational design of new vectors, CpG adjuvant activity, Transcutaneous immunization, Vaccination studies and recent advances in Malaria, Tuberculosis, HIV.

UNIT- IV COMMERCIALISATION & QUALITY CONTROL

- a) Quality control and regulations in vaccine research, In-vitro experimental validations for predictions of vaccines by software.
- b) Animal testing, Rational design to clinical trials, large scale production, Commercialization, ethics.

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Question Paper Pattern

MODEL QUESTION PAPER

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester BSc (Life sciences) Examination - Year
Branch

Subject:

Note: Draw neat, labeled diagrams wherever necessary.
Your answers should be specific to the questions asked.

Time: 02 Hours

Max Marks: 50



I. LONG ESSAYS (Answer any TWO of the following)

2x10=20 Marks

- 1.
- 2.
- 3.

II. SHORT ESSAYS (Answer any FIVE of the following)

5x4=20 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III. SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.

MODEL QUESTION PAPER

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester BSc (Life sciences) Examination - Year
Branch

Subject:

Note: Draw neat, labeled diagrams wherever necessary.

Your answers should be specific to the questions asked.

Time: 03 Hours

Max Marks: 70

I. LONG ESSAYS (Answer any TWO of the following)

2x15=30 Marks

- 1.
- 2.
- 3.

II. SHORT ESSAYS (Answer any FIVE of the following)

5x6=30 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III. SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.
