**B.Sc. BIOTECHNOLOGY**

| SEM | Course Code | Part | Course | Course Title | Ins. Hrs /Week | Credit | Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CIA | ESE | |
| I | 20U1LT1/LA1/LF1/LH1/LU1 | I | Language – I | | 6 | 3 | 25 | 75 | 100 |
| | 20UCN1LE1 | II | English - I | | 6 | 3 | 25 | 75 | 100 |
| | 20UBT1CC1 | III | Core – I | Essential Biodiversity | 5 | 5 | 25 | 75 | 100 |
| | 20UBT1CC2P | | Core – II | Essential Biodiversity – Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT1AC1 | | Allied –I | Microbiology - I: Bacteriology and Virology | 5 | 4 | 25 | 75 | 100 |
| | 20UBT1AC2P | | Allied –II | Microbiology - I: Bacteriology and Virology - Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UCN1AE1 | IV | AEC-I | Value Education | 2 | 2 | - | 100 | 100 |
| | | TOTAL | | | 30 | 21 | | | 700 |
| II | 20U2LT2/LA2/LF2/LH2/LU2 | I | Language – II | | 6 | 3 | 25 | 75 | 100 |
| | 20UCN2LE2 | II | English – II | | 6 | 3 | 25 | 75 | 100 |
| | 20UBT2CC3 | III | Core – III | Cytology and Cell Biology | 6 | 5 | 25 | 75 | 100 |
| | 20UBT2CC4P | | Core – IV | Cytology and Cell Biology - Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT2AC3 | | Allied – III | Microbiology – II: Applied Microbiology | 4 | 3 | 25 | 75 | 100 |
| | 20UBT2AC4P | | Allied –IV | Microbiology – II: Applied Microbiology – Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UCN2SE1 | IV | Skill Enhancement Course -I @ | Soft Skills Development | 2 | 2 | - | 100 | 100 |
| | | TOTAL | | | 30 | 20 | | | 700 |
| III | 20U3LT3/LA3/LF3/LH3/LU3 | I | Language– III | | 6 | 3 | 25 | 75 | 100 |
| | 20UCN3LE3 | II | English – III | | 6 | 3 | 25 | 75 | 100 |
| | 20UBT3CC5 | III | Core– V | Genetics and Evolution | 4 | 4 | 25 | 75 | 100 |
| | 20UBT3CC6 | | Core– VI | Genetics and Evolution - Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT3AC5 | | Allied– V | Biochemistry - I: Biomolecules | 4 | 3 | 25 | 75 | 100 |
| | 20UBT3AC6P | | Allied–VI | Biochemistry – I: Biomolecules - Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT3GE1 | IV | Generic Elective – I # | | 2 | 2 | - | 100 | 100 |
| | 20UCN3AE2 | | AEC-II | Environmental Studies | 2 | 2 | - | 100 | 100 |
| | | TOTAL | | | 30 | 21 | | | 800 |
| IV | 20U4LT4/LA4/LF4/LH4/LU4 | I | Language–IV | | 6 | 3 | 25 | 75 | 100 |
| | 20UCN4LE4 | II | English– IV | | 6 | 3 | 25 | 75 | 100 |
| | 20UBT4CC7 | III | Core– VII | Molecular Biology and Recombinant DNA Technology | 5 | 5 | 25 | 75 | 100 |
| | 20UBT4CC8P | | Core - VIII | Molecular Biology and Recombinant DNA Technology - Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT4AC7 | | Allied– VII | Biochemistry - II: Bioenergetics and Metabolism | 5 | 3 | 25 | 75 | 100 |
| | 20UBT4AC8P | | Allied–VIII | Biochemistry - II: Bioenergetics and Metabolism- Practical | 3 | 2 | 25 | 75 | 100 |
| | 20UBT4GE2 | IV | Generic Elective – II # | | 2 | 2 | - | 100 | 100 |
| | 20UCN4EA | V | Extension Activities | NCC, NSS, etc. | - | 1 | - | - | - |
| | | TOTAL | | | 30 | 21 | | | 700 |
| V | 20UBT5CC9 | III | Core – IX | Plant and Animal Physiology | 6 | 5 | 25 | 75 | 100 |
| | 20UBT5CC10 | | Core – X | Enzymology | 5 | 5 | 25 | 75 | 100 |
| | 20UBT5CC11 | | Core – XI | Immunology | 5 | 5 | 25 | 75 | 100 |
| | 20UBT5CC12P | | Core - XII | Plant and Animal Physiology, Enzymology, Immunology - Practical | 5 | 5 | 25 | 75 | 100 |
| | 20UBT5DE1 | | DSE – I ** | | 5 | 4 | 25 | 75 | 100 |
| | 20UBT5SE2 | IV | Skill Enhancement Course -II @ | | 2 | 2 | - | 100 | 100 |
| | 20UBT5SE3 | | Skill Enhancement Course -III @ | | 2 | 2 | - | 100 | 100 |
| | 20UBT5EC1 | | Extra Credit Course - I | General Intelligence for competitive examinations | - | 4* | -- | 100* | 100* |
| | | TOTAL | | | 30 | 28 | | | 700 |
| VI | 20UBT6CC13 | III | Core– XIII | Plant Biotechnology | 5 | 5 | 25 | 75 | 100 |
| | 20UBT6CC14 | | Core– XIV | Animal Biotechnology | 5 | 5 | 25 | 75 | 100 |
| | 20UBT6CC15 | | Core - XV | Bioinformatics and Biostatistics | 5 | 5 | 25 | 75 | 100 |
| | 20UBT6CC16P | | Core - XVI | Plant Biotechnology, Animal Biotechnology and Bioinformatics and Biostatistics- Practical | 5 | 5 | 25 | 75 | 100 |
| | 20UBT6DE2 | | DSE – II ** | | 5 | 4 | 25 | 75 | 100 |
| | 20UBT6DE3 | | DSE – III ** | | 4 | 4 | 25 | 75 | 100 |
| | 20UCN6AE3 | IV | AEC-III | Gender Studies | 1 | 1 | - | 100 | 100 |
| | 20UBT6EC2 | | Extra Credit Course - II | Biotechnology for competitive examinations | - | 4* | -- | 100* | 100* |
| | 20UBTAECA | | Extra Credit Course for all | Online Course | - | 1* | -- | - | - |
| | | | | **TOTAL** | 30 | 29 | | | 700 |
| | | | | **GRAND TOTAL** | 180 | 140 | - | - | 4300 |

## @ Skill Enhancement Courses

| SEMESTER | COURSE CODE | COURSE TITLE |
|---|---|---|
| V | 20UBT5SE2A | Environmental Biotechnology |
| | 20UBT5SE2B | Basics of Forensic Science |
| | 20UBT5SE3A | Industrial Fermentations |
| | 20UBT5SE3B | Molecular Diagnostics |

## ** Discipline Specific Electives

| SEMESTER | COURSE CODE | COURSE TITLE |
|---|---|---|
| V | 20UBT5DE1A | Genomics and Proteomics |
| | 20UBT5DE1B | Ecology and Environment Management |
| VI | 20UBT6DE2A | Bioanalytical tools |
| | 20UBT6DE2B | Medical Microbiology |
| | 20UBT6DE3A | IPR, Biosafety and Bioethics |
| | 20UBT6DE3B | Cancer and Stem Cell Biology |

## # Generic Elective for other major department

| SEMESTER | COURSE CODE | COURSE TITLE |
|---|---|---|
| III | 20UBT3GE1 | Edible Mushroom Cultivation Technology |
| IV | 20UBT4GE2 | Biofertilizer and Organic Farming |

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| I | 20UBT1CC1 | Core – I | ESSENTIAL BIODIVERSITY | 5 | 5 | 100 | 25 | 75 |

**Course Outcomes:**

1. Ensure imparting the knowledge on a concept of biodiversity and its advantages.
2. Describe the evolutionary relationship of microorganisms, plants and animal.
3. Demonstrate web resources in biodiversity and its conservation using modern tools.
4. Develop the conservation strategies to the beginners for improvement of natural resources.
5. Appraise the scientific attitude using modern tools for conserving biodiversity.

**Unit I Biodiversity and Conservation: 15 hours**

Concepts and components of Biodiversity, Genetic diversity, Species diversity, Ecosystem diversity, Biodiversity and climate change, Hot spots and biodiversity in India. Conservation of biodiversity: *In-situ* conservation and *Ex-situ* conservation. Strategies to conserve biodiversity, Organizations involved for conservation - CBD, IUCN, UNESCO, NBPGR, WWF and FAO. #JFM- Joint Forest Management and Chipko movement#.

**Unit II Microbial and plant diversity: 15 hours**

*Microbial diversity*: an overview, Whittaker's five kingdom classification. #Origin of earth, Levels of Microbial Biodiversity#, *Plant Biodiversity*: Characteristics and an outline classification of Algae (F.E. Fritsch), Fungi (Ainsworth, 1972), Bryophyta (Rothmaler, 1951), Pteridophyta (Reimer's System, 1954), Gymnosperms (Sporne, 1965), Angiosperm – Artificial & Natural system of classification.

**Unit III Animal Diversity: 15 hours**

Outline classification of kingdom Animalia; Study of invertebrates upto class level for protozoa, Coelenterata, Platyhelminthes, Aschelminthes, Mollusca, Annelida, and Arthropoda. General classification and characteristics of vertebrates : Fishes, amphibians, Reptiles, Aves and Mammals and # minor phyla#.

**Unit IV Insect Diversity: 15 hours**

Outline of classification of Insects, characters and types; Apis (Honeybee) – Bombyx (Silkworm) – Termites (White ants) – Lepidoptera (Butterfly) and Musca (House fly), Beetle (Rhinoceros), key pest of paddy. Economic importance of insects. Integrated pest management (IPM). Bio-insecticide and repellants.

**Unit V: Modern Tools and Web Resources for Biodiversity Studies: 15 hours**

Assessment of mapping of biodiversity; GIS/Remote sensing, GBIF, Catalogue of Life, OBIS, Avibase, Fishbase, Fishnet, UNEP-WCMC, ITIS, FAO, IBIS, Vertnet, ATCC, PCC, NCBI Taxonomy, AVIS, Indian Biodiversity Portal, Western Ghats Biodiversity Portal, #Biodiversity Information System#.

#.....#*Self-study portion*

**Text Books:**


T.B. 1. Gangulee Das and Datta. College Botany (Vol- II). New central Book Agency P. Ltd. 6th Edition, 2007).
T.B. 2. J.D. Aber and J.M. Melillo, Terrestrial Ecosystems: W.B. Saunders, 2011.
T.B. 3. Eugene P. Odum, Fundamentals of Ecology, Philadelphia, Saunders, 2003.
T.B. 4. Ekambaranatha Ayyar, Outlines of Zoology. Vol – I: S. Viswanathan (Printers and Publishers) Pvt.Ltd. Chennai. 2015.


**Books for References:**


1. M. Ingrowille, Diversity and Evolution of land plants, Chapman and Hall, 2012.
2. E.L. Jordan, and P.S.Verma, Invertebrate Zoology, S. Chand and Company Ltd., New Delhi. 2010.


**Web Reference: https://nptel.ac.in/courses/102104068/**

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | Title of the Paper | Hours | Credits |
|---|---|---|---|---|
| **I** | **20UBT1CC1** | **ESSENTIAL BIODIVERSITY** | **5** | **5** |

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Number of Matches= 44, Relationship : High | | | | | | | | | | |

**Prepared by:**
1. Dr. J. Sebastin Raj -

**Checked by:**
1. Dr. T. Nargis Begum
2. Dr. A. Khaleel Ahamed.

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| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| I | 20UBT1CC2P | Core – II | ESSENTIAL BIODIVERSITY– PRACTICAL | 3 | 2 | 100 | 25 | 75 |

**Course Outcomes:**

1. Acquire basic knowledge on animal and plant organization.
2. Describe the basic knowledge of evolutionary relationship living organisms.
3. Ensure imparting the knowledge on a concept of biodiversity and its advantages.
4. Analyze the status of endangered flora and fauna.
5. Generate the knowledge through field visit of botanical garden and zoological park.

**FAUNA**

1. **Study of following specimens**: *Euglena, Noctiluca, Paramecium, Physalia, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, Daphnia,* Millipede, Centipede, Beetle, *Chiton, Octopus.*
2. **Dissections/ Virtual demonstration:** Digestive system of Cockroach; Mouthparts,ovaryofcockroach; Mosquito mouth parts; Unstained mount of Placoid scales.
3. **Study of following specimens:** *Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus,Salamander*anythreecommonbirds,SquirrelandBat.
4. Studyofafewendangeredspeciesofamphibians,reptiles,birdsandmammalsof India.
5. To study the faunal composition (insects and mites)of soil samples (Berley'sfunnel).
6. To study faunal composition of water samples(Lucky drop method)
7. Report on visit to National Park/Wild life sanctuary/Botanical garden.

**FLORA**

8. Study through specimens/photographs/slides of
   a. Key stones species
   b. Ecads, Ecotypes, Ecophenes
9. Study through permanent slides and specimens (vegetative and reproductive structures) of *Coleacheate,Vaucheria,Polysiphonia,Rhizopus,Penicillium*and*Agaricus*;*Riccia,Anthoceros, Funaria; Selaginella, Pteris; Cycas, Pinus, Gnetum*
10. Study of them characteristic features of any one flowers for each family
    a. Malvaceae /Fabaceae/ Cruciferae/ Ranunculaceae (any one family)
    b. Compositae
    c. Euphorbiaceae,
    d. Poaceae/Liliaceae (any onefamily)

**Text Books:**


1. Gangulee Das and Datta. College Botany (Vol- II). New central Book Agency P. Ltd. 6th Edition, 2007.
2. J.D. Aber, and J.M. Melillo, Terrestrial Ecosystems: W.B. Saunders, 2010.
3. Eugene P. Odum, Fundamentals of Ecology, Philadelphia, Saunders, 2013.
4. Ekambaranatha Ayyar, Outlines of Zoology. Vol – I: S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai. 2015.


**Books for References:**


1. P. C. Vasishta, A.K. Sinha and Anilkumar, Botany for degree students, 2015.
2. M. Ingrowille, Diversity and Evolution of land plants, Chapman and Hall, 2012.


**Web Reference:** https://nptel.ac.in/courses/102104068/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | | | Title of the Paper | | | | Hours | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| I | 20UBT1CC2P | | | ESSENTIAL BIODIVERSITY–PRACTICAL | | | | 3 | | 2 |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Number of Matches= 44, Relationship : High | | | | | | | | | | |

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| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| I | 20UBT1AC1 | Allied – I | MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY | 5 | 4 | 100 | 25 | 75 |

**Course Outcomes:**

1. Develop an understanding on the different aspects of Bacteria, fungi, Virus and its history.
2. Relate, identify and discriminate among Prokaryotic and Eukaryotic organisms.
3. Explain the properties, structure and cultivation of Bacteria and Virus.
4. Describe the theory behind the practical parts in this course.
5. Analyze the different aspects of viral, bacterial diseases and research findings in the areas of Bioinformatics in microbial technology.

**UNIT I** **15 hours**

**History and Classification:** History of Microbiology, Concepts of Domain: Haeckel's three kingdom, #Whittaker's five kingdom#, Cavalier-Smith's six kingdom and outline of Bergey's Manual of Systematic Bacteriology. Early development of Virology, Nomenclature and Taxonomy of Eukaryotic viruses, Principles of virus taxonomy. Classification of Fungi (Alexopoulos), Microscope – Bright field, Dark field, Phase contrast.

**UNIT II** **15 hours**

**Structure and Organization:** Overview of Prokaryotic & Eukaryotic cell structure - Inclusion bodies – Endospores - Cell wall – Flagella & Pili – Glycocalyx. General properties of viruses, Structure of viruses, Capsids, Viruses with capsids of complex symmetry, viral envelopes, Classification of Bacterial and Archaeal viruses; #virulent double stranded DNA phages – Lytic and Lysogenic cycle#.

**UNIT III** **15 hours**

**Cultivation of Bacteria and Virus:** Macronutrients and micronutrients, nutritional types of microorganisms and growth factors. Culture media - chemical and physical types; functional types; #Isolation of pure culture#; Growth curve and Mathematics of Growth; Measurement of microbial growth – cell number and cell mass. Cultivation of viruses, Virus purification and assays.

**UNIT IV** **15 hours**

**Bacterial / Viral Detection & Antimicrobial agents:** Staining techniques: Acid-Fast Staining, Capsule Staining and Flagella Staining, Antimicrobial Susceptibility Testing – Kirby-Bauer method, Etest, Multidrug-resistant organisms. Viral assay – focus forming, endpoint dilution ($TCID_{50}$), Tunable resistive pulse sensing, and fluorescent-antibody assay. #Antibacterial drug: penicillin and cephalosporin#. Antiviral drug: Acyclovir and Tamiflu.

**UNIT V** **15 hours**

**Disease and Treatment**: Airborne diseases – Diphtheria and Mycobacterium tuberculosis; Food-borne and waterborne diseases – Typhoid Fever, Staphylococcal Food Poisoning, cholera and Botulism; Influenza (Flu), AIDS; Viroids and virusoids; Prion diseases. #Control of Microorganisms#; Bioinformatics in microbial Biotechnology.

**#.....#** **Self Study portion**

**Text Books:**


1. M. Joanne, Willey, M. Linda, Sherwood and J. Christopher, Woolverton, Prescott, Harley, and Klein's Microbiology, 7th edition, McGraw Hill, Colin Wheatley/Janice Roerig-Blong, 2008.
2. Stuart Hogg, Essential Microbiology, John Wiley & Sons, Ltd, 2005.
3. Uma Shankar Singh and Kiran Kapoor, Microbial Biotechnology, Oxford Book Company, 2010.

**UNIT I** Part I Section 1.1 -1.3, Part VII Section 19.4, 19.6 – 19.7, Part VI Section 16.1, 16.7, 18.1 **T.B-1**
**UNIT II** Part I Chapter 3 **T.B-2** & Part VI Section 16.2 – 16.4, Section 17.1 – 17.2 **T.B-1**
**UNIT III** Part II Section 5.1 – 5.8 Section 6.2 – 6.3, Part VI Section 16.5, 16.6, **T.B-1**
**UNIT IV** Part X Chapter 34, **T.B-1** & Part V Chapter 14 **T.B-2**
**UNIT V** Part X Section 38.1 – 38.4, Section 37.1 – 37.6, Part II Section 7.4 – 7.6 T.B-1; Chapter 3 **T.B.3.**

**Web References:**
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1182391/
https://nptel.ac.in/courses/102103015/#
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6428495/

**Books for Reference:**


1. J.M. Pelczar, E.C.S. Chan, and N.R. Krieg, Microbiology, 5th Edition Tata McGraw Hill Publishing Company, 2006.
2. R. Anantha Narayanan and C.K.J. Panikar, 6th Edition, General Microbiology, Orient Longman Pvt. Ltd., 2002.


Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| **Semester** | **Code** | | | **Title of the Paper** | | | | **Hours** | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|
| **I** | **20UBT1AC1** | | | **MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY** | | | | **5** | | **4** |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | | ✓ | | | ✓ | | ✓ | | |
| CO2 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | |
| CO4 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| Number of Matches= 44, Relationship : Moderate | | | | | | | | | | |

**Prepared by:**

1. Dr. Y. Arsia Tarnam

**Checked by:**

1. Dr. J. Sebastin Raj
2. Dr. A. Khaleel Ahmed

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| I | 20UBT1AC2P | Allied – II | MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY - PRACTICAL | 3 | 2 | 100 | 25 | 75 |

**Course Outcomes:**

1. Describe the basic principles of sterilization and media preparation.
2. Differentiate organisms based on structural and biochemical properties.
3. Develop skills associated with isolating and enumerating microorganisms from various sources.
4. Apply knowledge and skills gained in this course to be useful in further research.
5. Develop an understanding on the various aspects of Bacteria and Viruses.

1. Isolation & Enumeration of Microorganism from air.
2. Isolation & Enumeration of Microorganism from water and soil.
3. Pure culture techniques - pour plate; spread plate, streak plate.
4. Staining Techniques – Gram's staining, Negative staining, Spore's staining
5. Motility - Hanging drop method
6. Catalase and oxidase test.
7. Biochemical characterization of microorganisms – carbohydrate utilization and IMViC tests.
8. Measurement of Growth - Spectrophotometry
9. Isolation of Bacteriophage (that infect *E. coli*) from sewage
10. Quantitation of phage in sewage sample by phage plaque assay.
11. Demonstration of mechanical transfer of viruses in plants by sap inoculation.
12. Study of virus infected plant samples.
13. Burst size determination - A one step growth curve of Bacteriophage T4

**Text Books:**

1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.
2. P. Gunasekaran, Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.

**Books for Reference:**

1. W. Harry, J.R. Seeley, J. Paul, Van Demark and John J Lee, Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York. 1997.
2. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | | | Title of the Paper | | | | Hours | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| I | 20UBT1AC2P | | | MICROBIOLOGY I – BACTERIOLOGY & VIROLOGY - PRACTICAL | | | | 3 | | 2 |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | | ✓ | | | ✓ | | ✓ | | |
| CO2 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | |
| CO4 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | |
| Number of Matches= 44, Relationship : Moderate | | | | | | | | | | |

**Prepared by:**
1. Dr. Y. Arsia Tarnam

**Checked by:**
1. Dr. J. Sebastinraj
2. Dr. A. Khaleel Ahmed

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| II | 20UBT2CC3 | Core – III | CYTOLOGY AND CELL BIOLOGY | 6 | 5 | 100 | 25 | 75 |

**Course outcome:**

1. Gain Information literacy in basic concepts of cell biology and properties of cells.
2. Gain Knowledge in cell cycle, Cellular membranes and matrices.
3. Analyze and interpret the behavior of cells in their microenvironment in multi-cellular organisms with emphasis on cell-cell interactions,
4. Understand the chemical and molecular processes that occur inside cells.
5. Attain mastery in identifying the sub cellular organelles and describing their structure and function

**Unit I Fundamentals of cell biology: 18 Hours**

History and Discovery of cells, physiological properties of cells, Cell theory, Overview of Prokaryotic and Eukaryotic Cells, Plant and Animal cells, Cell cycle and its regulation; Cell division: mitosis; meiosis, #binary fission#.

**Unit II Cellular membranes and matrices**: **18 Hours**

Membrane models; chemical composition of membranes; transportation across cell membrane-active and passive transport, proton pumps associated (Na-K, Ca-calmodulin); extracellular matrices – structure and function; #cytoskeleton – structure and function#.

**Unit III Cellular organelles and its function: 18 Hours**

structure and functions of endoplasmic reticulum – smooth & rough; golgi complex; Lysosomes; vacuoles; ribosomes, microbodies, microtubules, microfilaments; centrosome, #cilia and flagella#; Mitochondria – structure and function; chloroplast – structure and function.

**Unit IV Nucleic Acids and Cell Signalling: 18 Hours**

Structure and function of Nucleus, Nucleolus, DNA and RNA, chromosome structure and function, special type of chromosome. Cell signaling and receptors**:** Signaling molecules and their receptors; intracellular signal transduction pathways, Structure, #mechanism and action of receptors#.

**Unit V Tools and techniques in cell biology: 18 Hours**

Microtome, cytochemical staining of cells and tissues, micrometry, Microscopy - Fluorescent Microscope, Electron microscopy - Scanning Electron Microscope, Transmission Electron Microscope, Confocal Laser Scanning Microscope, Atomic Force Microscope.

#.....#*Self-study portion*

**Text Books:**

**T.B.1**H. Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. Molecular Cell Biology, 6th edition, W.H. Freeman and Company, 2013.

**T.B.2** N.Arumugam, Cell Biology, 5rd edition, SARAS Publication, 2017.

**T.B.3**Aruna Sarangi, Principles of Cell Biology, 5th edition, Pacific Publication, Delhi, 2010.

Unit I Chapter IV, pg. 60-75, T.B-2.
Unit II Chapter X, Pg. 443-445, T.B-1.
Unit III Chapter XI-XV, Pg. 167-218,T.B-2.
Unit IV Chapter IV, Pg. 97-120, T.B-3.
Unit V Chapter II, Pg. 16-29, T.B-2.

**Books for References:**


1. T. A. Brown, Introduction to genetics: A molecular approach. 2nd Edition. Garland Science. 2016.
2. J. D. Watson Tania, A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. Molecular Biology of the Gene. 7th Edition. Benjamin/Cummings Publ. Co., Inc., 2015.
3. Benjamin Lewin. Genes XI. 9th Edition. Jones & Bartlett Learning, 2011.


**Web reference**:

1. https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/
2. https://swayam.gov.in/nd1_noc20_me04/preview
3. http://www.di.uq.edu.au/sparqglossary#b
4. https://micro.magnet.fsu.edu
5. https://cellbiology.med.unsw.edu.au

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | Title of the Paper | Hours | Credits |
|---|---|---|---|---|
| **II** | **20UBT2CC3** | **CYTOLOGY AND CELL BIOLOGY** | **6** | **5** |

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Number of Matches= 40, Relationship : High | | | | | | | | | | |

**Prepared by:**
1. Dr. B.Nazeema Banu

**Checked by:**
1. Dr. J. Sebastin Raj
2. Dr.A.KhaleelAhamed.

*****

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| II | 20UBT2CC4P | Core – IV | CYTOLOGY AND CELL BIOLOGY - PRACTICAL | 3 | 2 | 100 | 25 | 75 |

**Course outcome:**

1. Explain the structure of cells using microscopy and other analytical techniques.
2. Develop their skills in the preparation and identification of cell structures and their functions using staining techniques.
3. Gain expertise in cytochemical methods.
4. Identify the different stages of mitosis and meiosis
5. Design experiments to investigate a scientific problem and present advanced knowledge in the specialized fields of cell biology.

1. Microscopy–Observation of a typical plant (onion peel, Hydrilla leaf) and animal cell(Cheek cells with a cotton swab) by Simple and compound microscope.
2. Measurement of cells using ocular and stage micrometer
3. Study of structure of cell: Structure observation of Prokaryotic and Eukaryotic cell.
4. Analysis of transverse sections of stem, root and leaf for parenchyma, collenchyma, sclerenchyma cells
5. **Cell count -** Experiment on Count of Erythrocytes (Red Blood Corpuscles)
6. Experiment on Count of Leucocytes (White Blood Corpuscles)
7. **Cell Staining and Cytochemical methods**-Demonstration of Cellular and sub-cellular components of plant and animal cells.
8. Staining of fresh tissues like Squamous Epithelium/ Ciliated Epithelium
9. Experiment on Haemin Crystals.
10. **Cell division**: Study of different stages of meiosis by temporary preparation/ permanent slides of *Tradescantia* Flower bud.
11. **Cell division:** Study of different stages of mitosis by temporary preparation/ permanent slides of onion root tips.
12. **Cell division:** Binary fission of yeast

**Books for References:**


1. P.Gunasekaran. Laboratory Manual in Microbiology.2nd edition, New Age International, 2007.
2. Zsolt Fazekas, Cell Biology Laboratory Manual, 8th edition, university press, 2011.


**Web Reference**:

1. https://www.youtube.com/watch?v=wMgXsrpVrJg
2. https://www.youtube.com/watch?v=k1O9jBHgsxs
3. https://www.youtube.com/watch?v=5V52RzM84TM
4. https://www.youtube.com/watch?v=VJ678ceiiV0
5. https://www.youtube.com/watch?v=1wiQsGNg0T0

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | | | Title of the Paper | | | | Hours | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| II | 20UBT2CC4P | | | CYTOLOGY AND CELL BIOLOGY - PRACTICAL | | | | 3 | | 2 |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Number of Matches= 40, Relationship : High | | | | | | | | | | |

**Prepared by:**
Dr.B.Nazeema Banu

**Checked by:**
1. H.F.Seyed Mafiya Haniff
2. Dr.A.KhaleelAhamed.

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| II | 20UBT2AC3 | Allied – III | MICROBIOLOGY - II APPLIED MICROBIOLOGY | 4 | 3 | 100 | 25 | 75 |

**Course Outcomes:**

1. Describe the basics of soil microbes and their role in biogeochemical cycle.
2. Discuss the domains of microbiology and their applications in various industries.
3. Evaluate methods of microbial control and apply the proper methods necessary in a given scenario.
4. Explain about the medical and practical uses of microorganisms for the production of pharmaceutical products.
5. Employ basic laboratory skills for research in microbiology using scientific methods to explore natural phenomena.

**Unit I Soil Microbiology**: **12 hours**

Introduction to soil microorganisms – bacteria (cyanobacteria and actinobacteria), algae, fungi, protozoans, nematodes and viruses.Role of microorganisms in biogeochemical cycling - carbon cycle, nitrogen cycle and sulphur cycle. # Mycorrhiza- Role of Mycorrhizal fungi in plants#. Organic and inorganic nutrients in soil - phosphorous uptake, # nitrogen fixation#,Biofertilizers – definition, importance – types and their application methods.

**Unit II Food Microbiology**: **12 hours**

Food as a substrate for microorganisms – microorganisms important in food microbiology: molds, yeasts and bacteria. Principles and methods of food preservation - high temperature, low temperature, drying, # irradiation and chemical preservatives#.Spoilage of fruits, vegetables, meat, poultry, fish and sea food.Microbes as foods - SCP production.

**Unit III Industrial Microbiology**: **12 hours**

Industrial products derived from microbes: Production of yeast, ethyl alcohol, beer and vinegar. Citric acid production, lactic acid production. Production of antibiotic – penicillin and streptomycin, Vitamin production – riboflavin, # vitamin C and vitamin B12#.Role of microbes in biogas production, petroleum industry and mining.

**Unit IV Clinical Microbiology**: **12 Hours**

Epidemiology of infectious diseases, Hospital acquired infections, Infections of various organs and systems of the human body , Rapid diagnostic techniques for microbial diseases, Vaccinology : principle, methods of preparation, administration of vaccines, Treatment and diagnostic methods of Corona virus, SARS, H1N1, Dengue, Swine Flu, Biological warfare.

**Unit V Pharmaceutical microbiology**: **12 hours**

Probiotics and neutraceuticals – economic and legal considerations in pharmaceutical biotechnology,Vaccine design and production, classification, genetically recombinant vaccines-advantages and disadvantages.Chemical and physicochemical deterioration of pharmaceuticals, Preservation of medicines using antimicrobial agents.Types of sterile pharmaceutical products and its sterilization consideration, # quality control and quality assurance of sterile products#.

#--------#Self study portion

**Text books**

T.B. 1 Moshrafuddin Ahmed, Basumatary S.K., Applied Microbiology, MJP Publishers, 2006.
T.B. 2. Lansing M Prescott, John P Harley and Donald A Klein,Microbiology, 7th Edition, Mc Graw Hill publishers, New York, 2007.
T.B. 3 A. H. Patel, Industrial Microbiology, Lakshmi publications, NewDelhi, 2005.
T.B. 4 Hugo and Russells,Pharmaceutical Microbiology, edited by Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, Brendan F. Gilmore, 8th edition, Wiley-Blackwell publications, 2008.

**Books for Reference**


1. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology, 7th Edition, Elsevier India Private Ltd., New Delhi,2008.
2. Bernard R. Glick and Jack J. Pasternak.Molecular Biotechnology.Indian edition.Panima Publishing Corporation. 2002
3. R. Y. Stainer, J. L. Ingra Ham, M. L. Wheelis andP. R. Painter. General Microbiology. Macmillan, 1992.


**Web Reference**


https://link.springer.com/book/10.1007/0-306-46888-3

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1529671/


Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| **Semester** | **Code** | | | **Title of the Paper** | | | | **Hours** | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|
| **II** | **20UBT2AC3** | | | **MICROBIOLOGY - II APPLIED MICROBIOLOGY** | | | | **4** | | **3** |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| CO4 | | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| Number of Matches= 37, Relationship : High | | | | | | | | | | |

**Prepared by:**
1.Dr. A. Nishanthini

**Checked by:**
1. H.F.Seyed Mafiya Haniff
2. Dr.A.KhaleelAhamed.

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| II | 20UBT2AC4P | Allied – IV | MICROBIOLOGY - II APPLIED MICROBIOLOGY PRACTICAL | 3 | 2 | 100 | 25 | 75 |

**Course Outcomes**

1. Technical know-how on versatile techniques in applied microbiology.
2. Proficiency in designing and conducting experiments involving microbes.
3. Demonstrate the safe methods for isolation of bacteria, fungi and determination of their antibacterial and antifungal activity.
4. Illustrate the application of microbes in industries.
5. Apply technical skills necessary to support microbiology research study.

1. Isolation of VAM from the soil.
2.Study of Rhizobium from legume root nodules.
3. Isolation and identification of Actinomycetes.
4.Isolation and identification of bacteria and fungi from fruits and vegetables.
5. Isolation and identification of bacteria and fungi from fermented and stored foods.
6. Isolation of lactic acid bacteria from curd.
7. Detection of Bacteria in milk by
   - Methylene blue reductase test.
   - Phosphatase test.
8. Antibiotic sensitivity test: Kirby Bauer's method.
9. Antifungal tests.
10. Media formulation.
11. Wine production by yeast.
12.Extracellular activities of microorganisms – amylase, cellulase and lipase.

**Textbooks**

T.B. 1 James G. Cappuccino and Natalie Sherman. Microbiology: A laboratory Manual. 10th Edition. Benjamin Cummings. 2013.

T.B. 2. R. H. Baltz, A. L. Demain and J. E. Davies, Manual of Industrial Microbiology and Biotechnology, 3rd edition, ASM Publishers, 2010.

**Book for Reference**

1. Aneja K.R., Laboratory Manual of Microbiology & Biotechnology, 2nd edition, Scientific InternationalPvt. Ltd, New Delhi, 2013.

**Web Reference**

https://www.tandfonline.com/doi/full/10.1080/21553769.2015
https://microbiologyonline.org/file/7926d7789d8a2f7b207.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | | | Title of the Paper | | | Hours | | Credits | |
|---|---|---|---|---|---|---|---|---|---|---|
| II | 20UBT2AC4P | | | MICROBIOLOGY - II APPLIED MICROBIOLOGY -PRACTICAL | | | 3 | | 2 | |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| CO4 | | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ |
| Number of Matches= 40, Relationship : High | | | | | | | | | | |

**Prepared by:**
1. Dr. A. Nishanthini.

**Checked by:**
1. H.F.Seyed Mafiya Haniff
2. Dr.A.KhaleelAhamed

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| III | | Value Added Course | CLINICAL DIAGNOSTIC METHODS | | | 100 | - | - |

## SEMESTER III: VALUE ADDED COURSE - I

## CLINICAL DIAGNOSTIC METHODS

**Course Code:** **Max Marks:100**
**Hours/week:** **Internal Marks:**
**Credit:** **External Marks:**

**Course Outcomes:**

1. Develop fundamental understanding on diagnostic methods performed at laboratories and hospitals for diagnosing human diseases.
2. Learnt various techniques like blood glucose test, blood pressure measurement, blood cells counting, Lipid profile etc.
3. Demonstrate understanding of skills required to diagnose various disorders.
4. Improve awareness about the interface between values, believes and ethical decision making in therapeutic settings.
5. Analyse the most commonly encountered pathophysiological state(s) and/or disease mechanism(s), as well as any clinical testing requirements.

**UNIT I** **8 hours**

**Introduction to diagnostic methods**: Definition –*invitro* diagnostic methods – types, scope andapplications. Physical examination – palpation, percussion and auscultation.

**UNIT II** **8 hours**

**General Chemistry**: Measurement of base compounds in the body –urine routine examination – acidity, sugar, bilirubin, ketones, protein, nitrite, leukocyte esterase and fecal occult blood tests (FOBT).

**UNIT III** **8 hours**

**Haematology:** Study of the blood -complete blood count, coagulation tests (eg., INR),calcium level test, chloride, sodium, potassium, ESR test, bleeding time and clotting time.

**UNIT IV** **8 Hours**

**Microbiology:** Manifestation of infection and microbial causes of infection. Microscopic examination, antimicrobial susceptibility, KOH preparation, AFB testing, blood culture and basic metabolic panel.

**UNIT V** **8 hours**

**Health conditions and associated tests:** Heart disease lipid panel (cholesterol and triglyceride) – troponin, Respiratory disease – blood gas test, Diabetes – glucose and HbA1c, Renal disease – creatinine and BUN.

**Text Books:**

T.B. 1. Geoffrey Beckett, Simon W. Walker, Peter Rae, Peter Ashby.,Clinical Biochemistry.7th edition.John Wiley & Sons.Blackwell Publishing, 2006.
T.B. 2.M. N. Chatterjea, Rana Shinde. Textbook of medical Biochemistry. 6th edition, Jaypee Brothers, Medical Publishers (p) Ltd. New Delhi.

**Books for Reference:**

1. CA Burtis, ER Ashwood, Tietz Textbook of clinical chemistry.2nd edition.W.B. Saunders Co. 1999.
2. Cynthia C. Chernecky, Barbara J. Berger. Laboratory tests and diagnostic procedures.Elsevier health sciences. 2012.

3. Frances TalaskaFishbach, Marshall Barnett Lippincott Williams and Wilkins.A manual of laboratory and diagnostic tests. 2009.

**Web References:**

1. https://www.thoughtco.com/common-blood-chemistry-tests-608417.
2. https://advameddx-policy-primer-on-diagnostics-june-2011.pdf
3. http://www.gutenberg.org/files/47078/47078-h/47078-h.htm
4. https://digitalcommons.hsc.unt.edu/cgi/viewcontent.cgi?article=1036&context=hmedbks
5. http://www.chospab.es/biblioteca/DOCUMENTOS/Color_Atlas_of_Hematology_Practical_and_Clinical_Diagnosis_2004_Thieme.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| **Semester** | **Code** | | | **Title of the Paper** | | | | **Hours** | | **Credits** |
|---|---|---|---|---|---|---|---|---|---|---|
| **III** | Value Added Course | | | **CLINICAL DIAGNOSTIC METHODS** | | | | - | | - |
| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✔ | ✔ | | | ✔ | ✔ | ✔ | | ✔ | ✔ |
| CO2 | ✔ | ✔ | | | ✔ | ✔ | | ✔ | | ✔ |
| CO3 | ✔ | ✔ | ✔ | | ✔ | ✔ | | | ✔ | ✔ |
| CO4 | ✔ | ✔ | | | ✔ | ✔ | ✔ | ✔ | | ✔ |
| CO5 | ✔ | ✔ | ✔ | | ✔ | ✔ | ✔ | | ✔ | ✔ |
| Number of Matches= 35, Relationship : High | | | | | | | | | | |

**Prepared by:**

1.H.F.Seyed Mafiya Haniff

**Checked by:**

1.Dr.A.Nishanthini

2.Dr.A.Khaleel Ahamed

| Semester | Code | Course | Title of the Course | Hours | Credits | Max. marks | Internal marks | External marks |
|---|---|---|---|---|---|---|---|---|
| IV | | Value Added Course | HERBAL HEALTHCARE PRACTICES | | | 100 | - | - |

**Course Outcomes**

1. Create a comprehensive wellness plan incorporating herbal, dietary and lifestyle recommendations integrating self-awareness and lessons of nature.
2. Demonstrate the ability to critically analyze herbal research and contribute to the current body of herbal literature.
3. Integrate knowledge of raw materials, formulation, and herbal pharmacy for product development purposes
4. Bridge the information gap of evidence-based data and traditional knowledge so as to make rational decisions in developing safe and effective herbal products and formulas.
5. Gain advanced skills in Harvesting and processing of plant material and also in Rationale design, product preparation, and formulation of herbal products.

**Unit I: 8 hours**

**Herbal therapeutics:** Introduction to indigenous herbs in medicine, History of herbal medicine, formulations types-decoctions, legium, sooranam, baspam and others.

**Unit II 8hours**

**Herbal formulation for common diseases:** Treating common cold, flu, children illness and women illness, Managing diabetics and cardiovascular diseases.

**Unit III 8 hours**

**Herbs in food and nutrition:** Herbal food supplements, Nutritional supplements, culinary herbs, the nutritional value of herbs, beneficial use of herbs as a food supplement.

**Unit IV 8 hours**

**Herbal cosmetics and first aid kits:** Skin care herbal products-Soap, face Cream, Moisturizers, lip balms, eyeliner and Kajal, Hair care products, herbal first-aid kit specific for home and travel, Common household accidents and their first-aid treatment.

**Unit V 8 hours**

**Herbal gardening:**Parameters to check for growing herbs, Outdoor herbal gardening, Indoor herbal gardening, drying and packaging of herbs for marketing.

**Text Books:**

T.B. 1. Matthew Wood, The Practice of Traditional Western Herbalism: Basic Doctrine, Energetic, and Classification,2nd edition, North Atlantic books,2013

T.B. 2. David Hoffman, Medical Herbalism: The Science and Practice of Herbal Medicine, Healing Arts, 1st edition,2003

T.B. 3. Thomas Easley and Steven Horne, The Modern Herbal Dispensatory: A Medicine-Making Guide, 4th edition, North Atlantic Book,2016

**Books for Reference:**

1. Hung OL, Shih RD, Chiang WK, Nelson LS, Hoffman RS, Goldfrank LR. *Herbal preparation use among urban emergency department patients.* Academic Emergency Medicine,1997

2. Food and Drug Administration (FDA). Overview of dietary supplements. website:www.fda.gov/food/dietarysupplements/consumerinformation, 2010.

3. World Health Organization (WHO). “Traditional Medicine.” 2018

**Web reference**

http://www.who.int/topics/traditional_medicine/en/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

| Semester | Code | Title of the Paper | Hours | Credits |
|---|---|---|---|---|
| **III** | Value Added Course | **CLINICAL DIAGNOSTIC METHODS** | - | - |

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | Programme Specific Outcomes (PSOs) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
| CO1 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| Number of Matches= 41, Relationship : High | | | | | | | | | | |

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**Checked by:**
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