**Core Subject IMMUNOLOGY Code: 213003501**

 **SEMESTER V**

 **6 Hrs/Week**

**Credits 4**

**PREAMBLE:**

* ***To familiarize the student with basic principles, mechanism and recent developments in the immunology of infectious diseases.***
* ***To develop a better understanding of the applications of immune techniques.***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

|  |  |  |
| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Understand and Acquired the knowledge of Types of immunity, cells and organs involved in resistant system | Up to K3 |
| **CO 2** | Learn and differentiate the role of Antigens, haptens, adjuvants, Complement and Immunoglobulin and their types. It helps to known about the disease resistance mechanism  | Up to K3 |
| **CO 3** | Gain knowledge to apply the various technique for identifying Antigen and Antibody in host system by their interaction methods. | Up to K3 |
| **CO 4** | Demonstrate the adverse effect of MHC, hypersensitivity and autoimmune diseases. Due to this they learn transplant of graft accept and reject on basis of their presence of antigen | Up to K3 |
| **CO 5** | Explain the monoclonal antibody construction, its application and vaccine types recall the success of various methods for the prevention of cancer | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 – APPLICATION

UNIT – I: **[18 Hrs]**

History of immunology. Types of Immunity – innate and acquired immunity. Cells and organs involved in immune system Primary and Secondary lymphoid organs (Thymus, Bone marrow, Lymph node and spleen).

UNIT – II: **[18 Hrs]**

Antigens, haptens, adjuvants, Antigenicity – Humoral and cell mediated immunity. Immunogloblins – structure, types, characteristics and function. Complement pathway - types and it’s role.

UNIT – III: **[18 Hrs]**

Antigen – antibody interactions. Affinity and avidity – precipitation reaction- principles, methods and types, Flocculation - agglutination reactions – hemagglutination, Blood transformation process, Bacterial and passive agglutination. Radioimmunoassay, ELISA, flocculation. Immunoelectrophoresis and western blotting.

UNIT – IV: **[18 Hrs]**

Major Histocompatibility complex – class I and class II Antigens. Transplantation and its types, Graft rejection (GVH and HVG rejection); HLA tissue typing. Hypersensitivity – Types and Mechanism – Auto immune diseases – definition; types I diabetes ; Rhemutoid arthritis.

UNIT – V: **[18 Hrs]**

Hybridoma technology- Monoclonal antibodies, principle, construction and their applications. Vaccines and its types; Immunization schedule; concepts in Tumour immunology.

**TEXT BOOKS:**

1. Donald M. Weir, John Steward. Immunology. Immunology, 7th Edition. ELBS, London, 1993.
2. Ian Tizzard, Immunology: An introduction, Saunders College Publishing USA, 1995.
3. Ivan M. Roit. Essential immunology, Black well scientific publications, Oxford, 1994.
4. Richard A. Goldsby, Thmas J. Kindt Barbara A Osbourne, Kuby immunology, 4th Edition, W. H. Freeman and Co, New Yark.

**REFERENCE BOOKS:**

1. Peer J., Delves. Ivan M. Roit Academic Press, Encyclopeaedia of immunology, 2nd Edition, Academic Press. 1998, USA.
2. Roi, J. M., Brostaff, J. J., and Mal., D. K., Immunology, 4th Edition Mosby Publisher C. V., St. Louis, 1996.

**WEB RESOURCES: (URLs)**

1. UNIT I: 1. <https://www.ncbi.nlm.nih.gov/books/NBK279395/>
2. UNIT II:1. <https://www.thermofisher.com/in/en/home/life-science/antibodies/antibodies-learning-center/antibodies-resource-library/antibody-methods/immunoglobulin-structure-classes.html>
3. UNIT III: 1.<https://microbeonline.com/immunology-note/>, 2.<https://microbiologynotes.com/elisa-principle-types-and-applications/>
4. UNIT IV: 1.<http://njms.rutgers.edu/sgs/olc/mci/prot/2009/Hypersensitivities09.pdf>, 2.<https://gmch.gov.in/e-study/e%20lectures/Microbiology/30%20Immunology%20of%20Transplantation.pdf>
5. UNITV:1.<https://courses.lumenlearning.com/microbiology/chapter/polyclonal-and-monoclonal-antibody-production/>

**PEDAGOGY:** Blackboard, video clip presentation

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I(18 hrs)  |
| 1.1 | History of immunology. | 2 | Lecture | Black Board |
| 1.2 | Types of Immunity – innate and acquired immunity | 4 | Lecture | Black Board |
| 1.3 | Cells and organs involved in immune system  | 5 | Lecture | Black Board |
| 1.4 | Primary lymphoid organs -Thymus, Bone marrow. | 4 | Chalk & Talk | Black Board |
| 1.5 | Secondary lymphoid organs Lymph node and spleen | 3 | Chalk & Talk | Black Board |
| Unit -II(18 hrs)  |
| 2.1 | Antigens  | 2 | Lecture | Black Board |
| 2.2 | Haptens, adjuvants | 2 | Chalk & Talk | Black Board |
| 2.3 | Antigenicity – Humoral and cell mediated immunity | 5 | Chalk & Talk | Black Board |
| 2.4 | Immunogloblins – structure, types, characteristics and function | 5 | Chalk & Talk | Black Board |
| 2.5 | Complement pathway - types and it’s role  | 4 | Chalk & Talk | Black Board |
| Unit - III (18 hrs)  |
| 3.1 | Antigen – antibody interactions  | 1 | Lecture | Black Board |
| 3.2 | Affinity and avidity | 1 | Lecture | Black Board |
| 3.3 | Precipitation reaction- principles, methods and types | 3 | Chalk & Talk | Black Board |
| 3.4 | Flocculation - agglutination reactions – hem agglutination | 3 | Chalk & Talk | Black Board |
| 3.5 | Blood transformation process, Bacterial and passive agglutination | 4 | Chalk & Talk | Black Board |
| 3.6 | Radioimmunoassay, ELISA, flocculation. Immunoelectrophoresis | 4 | Chalk & Talk | Black Board |
| 3.7 | Western blotting | 2 | Chalk & Talk | Black Board |
| UNIT – IV (18 hrs)  |
| 4.1 | Major Histocompatibility complex – class I and class II Antigens.  | 4 | Lecture | Black Board |
| 4.2 | Transplantation and its types, Graft rejection (GVH and HVG rejection) | 4 | Lecture | Black Board |
| 4.3 | HLA tissue typing | 3 | Lecture | Black Board |
| 4.4 | Hypersensitivity – Types and Mechanism | 4 | Chalk & Talk | Black Board |
| 4.5 | Auto immune diseases – definition; types I diabetes ; Rhemutoid arthritis | 3 | Chalk & Talk | Black Board |
| Unit -V (18 hrs)  |
| 5.1 | Hybridoma technology  | 2 | Chalk & TalkLecture | Black Board |
| 5.2 | Monoclonal antibodies - Definition | 3 | Chalk & Talk | Ppt |
| 5.3 | Monoclonal antibodies principle, construction and their applications. | 3 | Lecture | Ppt |
| 5.4 | Vaccines and its types | 4 | Chalk & Talk | Black Board |
| 5.5 | Immunization schedule | 2 | Chalk & Talk | ppt |
| 5.6 | Concepts in Tumour immunology | 4 | Chalk & Talk | Black Board |

**MAPPING OF COS WITH POS**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 1 | 3 | 2 |
| **CO2** | 2 | 3 | 1 | 1 | 3 |
| **CO3** | 2 | 3 | 1 | 1 | 2 |
| **CO4** | 1 | 3 | 2 | 3 | 1 |
| **CO5** | 2 | 3 | 1 | 1 | 2 |

3 - STRONG 2- MEDIUM 1 - LOW

**COURSE DESIGNER: Mr. T. MUTHURAYAR**

**Core subject rDNA Technology Code : 213003502**

 **6 Hrs/Week**

 **Credits 4**

**PREAMBLE:**

* ***To learn about the role of enzymes and basic steps in gene cloning.***
* ***To understand the role of different types of vectors in Genetic Engineering***
* ***To acquire knowledge on gene recombination and***
* ***gene transfer techniques.***
* ***To gain the knowledge of gene library construction and gene sequencing techniques.***
* ***To understand the different methods of gene manipulation, blotting techniques and 16s rRNA sequencing.***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Explain the role of different enzymes responsible for gene manipulation and the basic steps of gene cloning | Up to K3 |
| **CO 2** | Depict the different types and functions of prokaryotic and eukaryotic vectors. |  Up to K3 |
| **CO 3** | Illustrate knowledge on gene recombination and gene transfer techniques |  Up to K3 |
| **CO 4** | Describe the DNA library constructions and gene sequencing methods. | Up to K3 |
| **CO 5** | Perform and analyze the gene manipulation techniques blotting techniques and 16s rRNA sequencing. |  Up to K3 |

K1 - Knowledge K2 - Understanding K3 - Application

UNIT – I: **[18 Hrs]**

Introduction, scope and applications of rDNA technology in various fields.Restriction enzymes- Nomenclature, types, mode of action, applications. Star activity, DNA modifying enzymes - S1 nuclease, DNA ligases, alkaline phosphatase.Homopolymer tailing, linkers and adaptors.

UNIT – II: **[18Hrs]**

Cloning vectors-desirable properties of ideal vectors.Prokaroyotic and eukaryotic hosts Plasmids- pBR322, cosmids, bacteriophage vectors- lambda phage, M13 phage vector, YAC, BAC, yeast vectors. Gene cloning strategies.

UNIT – III: **[18Hrs]**

Gene recombination and gene transfer: Microinjection, electroporation, biolistics, ultrasonication, liposome fusion. Screening and selection of recombinants, production of growth hormones - Insulin - Golden rice.

UNIT – IV: **[18 Hrs]**

DNA library: Genomic library and cDNA library construction, advantages and limitation. Blotting techniques – southern, Western and its applications. DNA sequencing methods- Maxam Gilbert and Sanger’s method, Automated DNA sequencing.

UNIT – V: **[18 Hrs]**

Techniques in rDNA technology: agarose electrophoresis - PCR, DNA finger printing, RAPD, RFLP, AFLP, Site directed mutagenesis, 16Sr RNA sequencing.

**TEXT BOOKS:**

1. A Text Book of Biotechnology, R. C. Dubey, 6th edition, S. Chand publication.
2. Molecular biotechnology- Principle and applications of recombinant DNA , Bernad R. Glick, Jack J. Pasternak, Cleryl. L. Patten, 4th edition.
3. Brown T. A., Gene cloning and DNA analysis, Blackwell Science, 2001.

**REFERENCE BOOKS:**

1. Principle of gene manipulation- R. W. Old & S. B. Primrose, 4th edition, Blackwell scientific publication, London, 1989.
2. Recombinant DNA- Watson, Gilman, Xotter, Jan Wit Kowski, 2nd Edition, 1992, W.H. Freeman.

**WEB REFERENCES**

01. Unit 1:

1. <https://en.wikipedia.org/wiki/Restriction_enzyme>
2. <https://nptel.ac.in/courses/102103013/>

02. Unit 2:

1. [https://en.wikipedia.org/wiki/Vector\_(molecular\_biology)](https://en.wikipedia.org/wiki/Vector_%28molecular_biology%29)

03. Unit 3:

1. <https://www.ncbi.nlm.nih.gov/books/NBK217998/>
2. <http://www.biologydiscussion.com/gene/gene-transfer/methods-of-gene-transfer-6-methods/9826>

04. Unit 4:

1. [https://en.wikipedia.org/wiki/Blot\_(biology)](https://en.wikipedia.org/wiki/Blot_%28biology%29)
2. <https://en.wikipedia.org/wiki/DNA_sequencing>
3. <https://nptel.ac.in/content/storage2/courses/102103045/download/mod3.pdf>

0.5 Unit 5:

1. <https://en.wikipedia.org/wiki/Genetic_engineering>
2. <https://en.wikipedia.org/wiki/Polymerase_chain_reaction>
3. <https://jcm.asm.org/content/45/9/2761>
4. [https://en.wikipedia.org/wiki/Blot\_(biology)](https://en.wikipedia.org/wiki/Blot_%28biology%29)

**PEDAGOGY:** Chalk and Talk, Powerpoint presentation, Animations

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit –I [18 Hrs] |
| 1.1 | Introduction to rDNA technology. | 2 | Lecture | Black Board |
| 1.2 | Scope and applications of rDNA technology in various fields. | 2 | Lecture | Black Board |
| 1.3 | Restriction Enzymes- Nomenclature | 2 | Lecture | Black Board |
| 1.4 | Types of Restriction Enzymes , mode of actions. | 2 | Chalk & Talk | Black Board |
| 1.5 | Applications, Star activity of Restriction Enzymes- | 2 | Chalk & Talk | Black Board |
| 1.6 | DNA modifying enzymes - S1 nuclease | 2 | Chalk & Talk | Black Board |
| 1.7 | DNA ligases & alkaline phosphatase. | 2 | Chalk & Talk | Black Board |
| 1.8 | Homopolymer tailing | 2 | Chalk & Talk | Black Board |
| 1.9 | linkers and adaptors | 2 | Chalk & Talk | Black Board |
| Unit –II [18 Hrs] |
| 2.1 | Vectors-desirable properties of ideal vectors | 2 | Lecture | Black Board |
| 2.2 | Prokaroyotic and eukaryotic hosts | 3 | Chalk & Talk | Black Board |
| 2.3 | Plasmids- pBR322 | 2 | Chalk & Talk | Black Board |
| 2.4 | Cosmids | 2 | Chalk & Talk | Black Board |
| 2.5 | Bacteriophage vectors- lambda phage, M13 phage vector. | 4 | Chalk & Talk | Black Board |
| 2.6 | YAC, BAC, yeast vectors. | 3 | Chalk & Talk | Black Board |
| 2.7 | Gene cloning strategies. | 2 | Chalk & Talk | Black Board |
| Unit –III [18 Hrs] |
| 3.1 | Gene recombination and gene transfer: Microinjection | 2 | Lecture | Black Board |
| 3.2 | Electroporation | 2 | Chalk & Talk | Black Board |
| 3.3 | Biolistics | 2 | Chalk & Talk | Black Board |
| 3.4 | Ultrasonication, liposome fusion | 4 | Chalk & Talk | Black Board |
| 3.5 | Screening and selection of recombinants. | 4 | Chalk & Talk | Black Board |
| 3.6 | Production of growth hormones | 2 | Chalk & Talk | Black Board |
| 3.7 | Production of Insulin | 1 | Chalk & Talk | Black Board |
| 3.8 | Production of Golden rice. | 1 | Chalk & Talk | Black Board |
| Unit- IV [18 Hrs] |
| 4.1 | DNA library:  | 1 | Lecture | Black Board |
| 4.2 | Genomic library | 2 | Chalk & Talk | Black Board |
| 4.3 | cDNA library construction | 2 | Chalk & Talk | Black Board |
| 4.4 | cDNA library construction-advantages and limitation. | 2 | Chalk & Talk | Black Board |
| 4.5 | blotting techniques – southern, Western and its applications.  | 4 | Chalk & Talk | Black Board |
| 4.6 | DNA sequencing method- Maxam Gilbert | 2 | Chalk & Talk | Black Board |
| 4.7 | DNA sequencing method -Sanger’s method. | 3 | Chalk & Talk | Black Board |
| 4.8 | Automated DNA sequencing. | 2 | Chalk & Talk | Black Board |
| Unit –V [18 Hrs] |
| 5.1 | Techniques in rDNA technology: agarose electrophoresis | 2 | Chalk & TalkLecture | Black Board |
| 5.2 | PCR | 2 | Chalk & Talk | Black Board |
| 5.3 | DNA finger printing | 2 | Chalk & Talk | Black Board |
| 5.4 | RAPD, RFLP, AFLP | 6 | Chalk & Talk | Black Board |
| 5.6 | Site directed mutagenesis | 2 | Chalk & Talk | Black Board |
| 5.7 | 16Sr RNA sequencing | 4 | Chalk & Talk | Black Board |

**MAPPING OF COS WITH POS**

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|  **POs****Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 1 | 2 | 3 |
| **CO2** | 3 | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 2 | 3 | 1 | 2 |
| **CO4** | 2 | 3 | 1 | 2 | 2 |
| **CO5** | 2 | 1 | 2 | 3 | 3 |

3 – STRONG 2– MEDIUM 1 – LOW

**COURSE DESIGNER: P.GAYATHRI DEVI**

**Core Subject CLINICAL MICROBIOLOGY Code: 213003503**

 **SEMESTER V**

 **6Hrs/Week**

 **Credits 4**

**PREAMBLE:**

* ***To have a basic knowledge on normal microbial flora of the human body and microbial pathogenicity***
* ***To understand the relevance between microorganisms and infectious diseases***
* ***To acquire the requisite knowledge on the hygienic practices, principles of prevention and treatment of pathogenic microbial infections in humans***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Comprehend the basis and types of normal microbial flora of the human body besides collection and storage of biological fluids of the body | Up to K3 |
| **CO 2** | Ascertain the common microbial pathogenicity and epidemiology, prevention and control of infectious diseases of Bacteria | Up to K3 |
| **CO 3** | Demonstrate the epidemiology and hygienic in preventing parasitic diseases | Up to K3 |
| **CO 4** | Illustrate the root causes and sanitation methods in managing mycotic infections | Up to K3 |
| **CO 5** | Identify the relationship between the viruses and their infection in humans and Critically analyze the methods of treatments for viral diseases | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 - APPLICATION

UNIT – I: **[18Hrs]**

Normal microflora of healthy human body - Skin, respiratory tract, gastrointestinal tract & genitourinary tract; collection of Specimen - transport and storage of cerebrospinal fluid and blood.

UNIT – II: **[18 Hrs]**

 Harmful Microbial Interactions with Human : Entry of pathogens into the host, Mechanism of bacterial pathogenicity, colonization and growth, Virulence factors, damage to host cell. Mode of entry, symptoms, pathogenesis, laboratory diagnosis, prevention and control of bacterial diseases - typhoid, tuberculosis and cholera.

UNIT – III  **[18 Hrs]**

Characteristic features, lifecycle, symptoms, pathogenesis, lab diagnosis, prevention and control of protozoan disease- Malaria, Amoebiasis, Ascariasis, Lymphatic filariasis.

UNIT – IV:  **[18 Hrs]**

Characteristic features, mode of entry, symptoms, pathogenesis, lab diagnosis, prevention and control of fungal disease - Superficial mycoses - Ringworm; cutaneous mycoses - *Tinea pedis, Tinea cruris*; Systemic mycoses - Histoplamosis, *Coccidiosis; Opportunistic mycoses- Aspergillosis, Candidiasis. and Mucormycosis*.

UNIT – V: **[18 Hrs]**

 Introduction to viruses – definition, properties, Structural characteristics of Virus – Animal viruses - Hepatitis B, Pox virus – classification, life cycle, pathogenicity, preventive measures and treatment – Corona virus, Dengue, and HIV. Cultivation of viruses – embryonated eggs, laboratory animals and cell culture.

**TEXT BOOKS:**

1. Douglas Sleign, Morag, C. Timbury. Notes on Medical bacteriology. Churchill Livingstone publication.
2. Greenwood D., Slack R.C.B., and Peutherer J. E., Medical Microbiology, A Guide to microbial Infection, ELST publisher, Churchill Livingstone London, 1997.
3. Morag C. Timbury., Notes on Medical virology, 11th Edition Churchill living stone (Medical division of Pearson Professional Limited) , 1997

**REFERENCE BOOKS:**

1. Ronald M. Atlas, Principles of Microbiology- Second Edition, WM. C. Brown Publisher.
2. Anantha Narayan and Jayram Panikar, (2000), Text book of Microbiology, Orient Longman, Delhi, Kakinada.
3. Dimmock. N.J., and Primrose. S.B., Introduction to modern Virology, 4th edition, Blackwell publishing Ltd., 1994

**WEB RESOURCES: (URLs:)**

01. Unit - I: 1.<http://textbookofbacteriology.net/normalflora.html>

 2.<https://pdfs.semanticscholar.org/32ed/d15bca381c4deb4d71079c2c857ea34e6473.pdf>

02. Unit-II : 1.<https://nptel.ac.in/courses/102103015/>

 2. <https://health.ri.gov/diseases/infectious/>

03. Unit -III: 1.<https://health.ri.gov/diseases/infectious/>

 2.<https://www.cdc.gov/parasites/az/index.html>

04. Unit-IV: 1. <https://health.ri.gov/diseases/infectious/>

 2.<https://www.cdc.gov/fungal/diseases/index.html>

05. Unit-V: 1.<https://health.ri.gov/diseases/infectious/>

 2.<https://www.cdc.gov/diseasesconditions/az/h.html>

 3.<https://www.cdc.gov/diseasesconditions/index.html>

**PEDAGOGY:** Chalk and Talk, Power point presentation.

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I [18 Hrs] |
| 1.1 | Normal microflora of healthy human body  | 3 | Chalk & Talk | Black Board |
| 1.2 | Micro flora of Skin, respiratory tract | 4 | Chalk & Talk | Black Board |
| 1.3 | Micro flora of gastrointestinal tract & genitourinary tract | 5 | Lecture | Power point presentation |
| 1.4 | Collection of Specimen - transport and storage of cerebrospinal fluid  | 3 | Chalk & Talk | Black Board |
| 1.5 | Collection of Specimen - transport and storage of blood. | 3 | Lecture | Power point presentation |
| Unit - II [18 Hrs] |
| 2.1 | Harmful Microbial Interactions with Human  | 3 | Chalk & Talk | Black Board |
| 2.2 | Entry of pathogens into the host | 2 | Chalk & Talk | Black Board |
| 2.3 | Mechanism of bacterial pathogenicity, colonization and growth | 3 | Chalk & Talk | Black Board |
| 2.4 | Virulence factors, damage to host cell.  | 2 | Lecture | Power point presentation |
| 2.5 | Mode of entry, symptoms, pathogenesis, laboratory diagnosis, prevention and control of bacterial diseases - Typhoid | 3 | Lecture | Power point presentation |
| 2.6 | Mode of entry, symptoms, pathogenesis, laboratory diagnosis, prevention and control of Tuberculosis | 2 | Lecture | Power point presentation |
| 2.7 | Mode of entry, symptoms, pathogenesis, laboratory diagnosis, prevention and control of Cholera | 3 | Lecture | Power point presentation |
| Unit - III [18 Hrs] |
| 3.1 | Characteristic features, lifecycle, symptoms, pathogenesis, lab diagnosis, prevention and control of protozoan disease- Malaria | 5 | Chalk & Talk | Black Board |
| 3.2 | Characteristic features, lifecycle, symptoms, pathogenesis, lab diagnosis, prevention and control of protozoan disease- Amoebiasis | 4 | Lecture | Power point presentation |
| 3.3 | Characteristic features, lifecycle, symptoms, pathogenesis, lab diagnosis, prevention and control of protozoan disease- Ascariasis | 4 | Lecture | Power point presentation |
| 3.4 | Characteristic features, lifecycle, symptoms, pathogenesis, lab diagnosis, prevention and control of protozoan disease- Lymphatic filariasis. | 5 | Lecture | Power point presentation |
| Unit - IV [18 Hrs] |
| 4.1 | Characteristic features, mode of entry, symptoms, pathogenesis, lab diagnosis, prevention and control of fungal disease - Superficial mycoses - Ringworm | 4 | Chalk & Talk | Black Board |
| 4.2 | Cutaneous mycoses - *Tinea pedis, Tinea cruris*;  | 4 | Chalk & Talk | Black Board |
| 4.3 | Systemic mycoses - Histoplamosis, *Coccidiosis* | 4 | Chalk & Talk | Black Board |
| 4.4 | *Opportunistic mycoses- Aspergillosis, Candidiasis.*  | 4 | Chalk & Talk | Black Board |
| 4.5 | *Mucormycosis*. | 2 | Lecture | Power point presentation |
| Unit - V [18 Hrs] |
| 5.1 | Introduction to viruses – definition, properties, Structural characteristics of Virus. | 3 | Chalk & Talk | Black Board |
| 5.2 | Animal viruses - Hepatitis B, Pox virus – classification. | 3 | Lecture | Power point presentation |
| 5.3 | Life cycle, pathogenicity, preventive measures and treatment of Corona virus. | 4 | Chalk & Talk | Black Board |
| 5.4 | Life cycle, pathogenicity, preventive measures and treatment of Dengue,  | 2 | Chalk & Talk | Black Board |
| 5.5 | Life cycle, pathogenicity, preventive measures and treatment of HIV.  | 2 | Chalk & Talk | Black Board |
| 5.6 | Cultivation of viruses – embryonated eggs, laboratory animals and cell culture. | 2 | Chalk & Talk | Black Board |
| 5.7 | Laboratory animals and cell culture. | 2 | Chalk & Talk | Black Board |

**MAPPING OF COS WITH POS**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 1 | 2 | 1 | 3 |
| **CO2** | 2 | 3 | 2 | 1 | 2 |
| **CO3** | 1 | 2 | 1  | 2  |  3 |
| **CO4** | 3 |  1 | 2 | 1 | 2 |
| **CO5** | 2 | 3 | 2  |  1  | 2 |

3 - STRONG 2- MEDIUM 1 - LOW

**COURSE DESIGNER: Mr. L.ARUL YESUDOSS.**

**Core Lab** **LAB IN IMMUNOLOGY and rDNA TECHNOLOGY**

##  SEMESTER V Code:213003504

 **3 Hrs/Week**

 **Credits 3**

**PREAMBLE**:

* **To enable a student to acquire sound knowledge and practical skills to contribute effectively in immunology.**
* **To understand antibody production and antigen-antibody interaction.**
* **To acquire practical skills necessary to isolate, construct and use Recombinant DNA molecule in Genetic engineering.**
1. Antigen preparation.
2. Serum and Plasma separation.
3. Immuno diffusion
4. Radial immuno diffusion technique.
5. Ouchterlony’s double diffusion method.
6. Agglutination reactions-Widal, HCG.
7. Immunoelectrophoresis
8. Rocket Immunoelectrophoresis.
9. ELISA- Dot method.
10. Isolation of DNA from Plant and Animal tissue.
11. Isolation of Plasmid DNA from Bacteria.
12. Transformation and screening of transformants based on blue white selection.
13. Industrial visit

**TEXT BOOKS:**

1. Talwar G.P., and Gupta S.K., A Handbook of Practical Immunology (Vol I and II), Vikas publishing house private limited, New Delhi, 1992.
2. Glover D.M., and Hames B.D., DNA Cloning-A Practical Approved(VL-4) LRL Press,1995.

**REFERENCE BOOKS:**

1. Weis D.M., Handbook of Experimental Immunology (Vol-I to IV), Blackwell Scientific publishers. USA, 1986.
2. Brown T. A., Lab – Molecular Biology, Lab Fax – II – Gene analysis, 2nd Edition, Academic press, UK, 1998.

**COURSE DESIGNER: P.GAYATHRI DEVI**

**Elective - I GENOMICS AND PROTEOMICS****Code: 213003505**

**SEMESTER VI**

**5 HOURS/WEEK CREDIT: 4**

***Course preamble:-***

* ***To inculcate knowledge in transcriptomics and gene prediction of living things.***
* ***To implement the knowledge knowledge on systematic analysis, evolutionary studies, drug targeting & Drug designing using modern software tools.***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Describe and analyse the structural organization and sequencing of genome | Up to K3 |
| **CO 2** | Portray the expression of gene using transcriptomic techniques | Up to K3 |
| **CO 3** | Depict the structural analysis and protein expression | Up to K3 |
| **CO 4** | Illustrate the genome projects and drug mechanism | Up to K3 |
| **CO 5** | Analyse the phylogeny of organisms, metabolic pathways and evolutionary relationship | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 - APPLICATION

UNIT – I: **[15 Hrs]**

 Definition of genomics and proteomics – Structural organization of prokaryote and eukaryote genome – DNA sequencing methods, Conventional sequencing (Sanger, Maxam and Gilbert method),Automated sequencing and its applications.

UNIT – II: **[15 Hrs]**

 Transcriptomics – Transcript and analysis – Global gene expression analysis – Differential display analysis, Differential gene expression analysis – DNA microarray technology – Whole transcriptome analysis – SAGE (Serial Analysis of Gene Expression).

UNIT – III: **[15 Hrs]**

 Proteomics – Introduction,types.concepts of proteome analysis –Protein – Protein interaction – Yeast two hybrid system – Computational approaches to analyse protein – Mass spectrometry for proteome analysis-2D gel electrophoresis.

UNIT – IV: **[15 Hrs]**

 Human Genome: Ethics, analysis – Pharmacogenetics – Drug discovery, Target and Developments – SNP analysis.

UNIT – V: **[15 Hrs]**

 Metabolomics: Introduction, principle and applications –Phylogenomics-Terminologies-Homolog,Ortholog,Paralog and Xenolog-Phylogenetic tree analysis methods-Maximum parsimony method,Distancemethod,Maximum likelihood method.

**TEXT BOOKS:**

1. Andrew J., and Link L.D., Proteome Analysis Protocols, Human Press, New Jensey, 1998.
2. Me Chelland M., and Anthor Pardee, Expression Genetics: Accelerated and High Throughout Methods, Biotechniques Press Eaton Publishing, USA, 1999.
3. Ignacimuthu S., Basic Bioinformatics,Naroza publishing House Pvt Ltd,New Delhi,2006.

**REFERENCE BOOKS:**

1. Mark Schrma, DNA Micro Arrays: A Practical Approach, Oxford University Press and Oxford England, 1999.
2. William M.R., Appel R.D., and Hrchstracsr D.F., Proteome Research: New Tronfiers in Functional Genomics: Principles and Practice, Springer Vetrlap, New York, 1997

**Web Resources: (URLs)**

01. UNIT I: 1**.**<https://onlinelibrary.wiley.com/doi/full/10.1038/npg.els.0005008>

02. UNIT II:1.<https://en.wikipedia.org/wiki/Genomics>

03.UNITIII:1.<http://www.auburn.edu/academic/agriculture/fisheries/genomics/FISH7660%202006/DNA%20marker%20review%20paper-Aquaculture.pdf>

04. UNIT IV:1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2435252/>

05. UNIT V: 1.<https://www.ncbi.nlm.nih.gov/books/NBK83754/>,

<https://link.springer.com/article/10.1007/s11568-007-9003-8>

**PEDAGOGY:** Chalk and Talk, video clip presentation

 **COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I (15Hrs) |
| 1.1 |  Definition of genomics and proteomics. | 2 | Lecture | Black Board |
| 1.2 | Structural organization of prokaryote genome | 2 | Lecture | Black Board |
| 1.3 | Structural organization of Eukaryote genome | 4 | Lecture | Black Board |
| 1.4 | DNA sequencing method- Sanger method. | 2 | Chalk & Talk | Black Board |
| 1.5 | Maxam and Gilbert method | 3 | Chalk & Talk | Black Board |
| 1.6 | Automated sequencing and its applications.  | 2 | Chalk & Talk | Black Board |
| Unit -II (15Hrs) |
| 2.1 | Transcriptomics – Transcript and analysis | 2 | Lecture | Black Board |
| 2.2 | Global gene expression analysis | 2 | Chalk & Talk | Black Board |
| 2.3 | Differential display analysis | 2 | Chalk & Talk | Black Board |
| 2.4 | Differential gene expression analysis | 2 | Chalk & Talk | Black Board |
| 2.5 | DNA microarray technology | 3 | Chalk & Talk | Black Board |
| 2.6 | Whole transcriptome analysis | 2 | Chalk & Talk | Black Board |
| 2.7 | SAGE (Serial Analysis of Gene Expression). | 2 | Chalk & Talk | Black Board |
| Unit – III (15Hrs) |
| 3.1 | Proteomics – Introduction | 2 | Lecture | Black Board |
| 3.2 | Proteomics – types. concepts of proteome analysis | 3 | Lecture | Black Board |
| 3.3 | Protein – Protein interaction  | 3 | Chalk & Talk | Black Board |
| 3.4 | Yeast two hybrid system. | 2 | Chalk & Talk | Black Board |
| 3.5 | Computational approaches to analyse protein | 1 | Chalk & Talk | Black Board |
| 3.6 | -Mass spectrometry for proteome analysis. | 2 | Chalk & Talk | Black Board |
| 3.7 | 2D gel electrophoresis. | 2 | Chalk & Talk | Black Board |
| Unit- IV (15Hrs) |
| 4.1 | Human Genome: Ethics, analysis | 3 | Lecture | Black Board |
| 4.2 | Pharmacogenetics | 3 | Lecture | Black Board |
| 4.3 | Drug discovery | 4 | Lecture | Black Board |
| 4.4 | Target and Developments | 3 | Chalk & Talk | Black Board |
| 4.5 | SNP analysis. | 2 | Chalk & Talk | Black Board |
| Unit -V (15Hrs)  |
| 5.1 | Metabolomics: Introduction. | 2 | Chalk & TalkLecture | Black Board |
| 5.2 | Principle and applications | 3 | Chalk & Talk | Black Board |
| 5.3 | Phylogenomics - Terminologies-Homolog, Ortholog, Paralog and Xenolog | 2 | Chalk & Talk | Black Board |
| 5.4 | Phylogenetic tree analysis methods | 2 | Chalk & Talk | Black Board |
| 5.5 | Maximum parsimony method, Distance method,Maximum likelihood method. | 6 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| --- | --- | --- | --- | --- | --- |
| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 1 | 1 | 2 |
| **CO2** | 2 | 1 | 3 | 2 | 1 |
| **CO3** | 2 | 2 | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 1 | 2 | 3 |
| **CO5** | 1 | 3 | 2 | 3 | 1 |

3 – STRONG 2 – MEDIUM 1 – LOW

**COURSE DESIGNER: Mrs. P.GAYATHRIDEVI**

**Elective-I PHARMACEUTICAL MICROBIOLOGY Code: 213003506**

 **SEMESTER V**

 **5 Hrs/Week**

 **Credits 5**

**PREAMBLE:**

* ***To understand the various modes of action of different types of antimicrobial agents***
* ***To study the various microbial growth controlling techniques and various other tests used for detection of microorganisms.***
* ***To elucidate the various mechanisms of drug resistance***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Describe the basis of evaluation of antiseptics and spoilage of drugs | Up to K3 |
| **CO 2** | Employ the physical and chemical methods to control the microorganisms in order to understand the dynamics to produce pharmaceuticals against pathogens | Up to K3 |
| **CO 3** | Analyze the methods available to test the sterility of the pharmaceutical products that are useful to quantify the efficacy of the drug | Up to K3 |
| **CO 4** | Examine various screening techniques employed to evaluate the drugs | Up to K3 |
| **CO 5** | Compare and distinguish the classes of antibiotics and critically analyze the drug resistance ability of pathogens & production and mode of actions of antibiotics | Up to K3 |

K1 - Knowledge K2 - Understanding K3 - Application

UNIT – I: **[15 Hrs]**

Introduction to scope of pharmaceutical microbiology. Antiseptics & their evaluation: chick Martin test, Rideal Walker test. Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, noninjectibles, ophthalmic preparation & implants).

UNIT – II: **[15 Hrs]**

Microbial control: Physical method - heat, moist heat, cold, radiation. Chemical method: disinfectants - methods, variants - alcohol, aldehyde, ethylene oxide, heavy metal, halogen, organic acid, oxidizing agents, phenol, surfactant. Experimental parameters influencing the antimicrobial agent activity. Factors influencing activity of disinfectants.

UNIT – III:  **[15 Hrs]**

Sterility testing of pharmaceutical products: introduction, membrane filtration, direct inoculation- nutrient broth, cooked meat medium, sabouraud medium, sampling probability profile.

UNIT – IV:  **[15 Hrs]**

 Microbiological assays: Basic principle, methodologies – cylinder –plate and turbidometric method. Assay of antibiotics – chlorotetraucline, Assay of vitamin – Niacin, Assay of Amino acids.

UNIT – V:  **[15 Hrs]** Classification of Antibiotics - Drug resistance of pathogens. Mechanism of action of antibiotics- inhibitor of cell wall synthesis, nucleic acid and protein synthesis - Production of semi synthetic antibiotics - derivatives of Penicillin.

**TEXT BOOKS:**

1. Pharmaceutical microbiology: Ashutosh Kar. New age International Publishers.
2. Pharmaceutical Microbiology – Edt by W.B. Hugo & A.D.Russell Sixth edition. Blackwell scientific publications.

**REFERENCE BOOKS:**

1. Pelczar and Reid, Text book of Microbiology
2. Anantha Narayan and Jayram Panikar, (2000), Text book of Microbiology, Orient Longman, Delhi, Kakinada.

**WEB RESOURCES: (URLs:)**

01. Unit - I: 1.<https://www.fda.gov/files/about%20fda/published/Pharmaceutical-Microbiology-Manual.pdf>

 2. [http://www.pharmamicroresources.com/2018/01/pharmaceutical-microbiology- playing.html](http://www.pharmamicroresources.com/2018/01/pharmaceutical-microbiology-playing.html)

 3. <https://cmr.asm.org/content/12/1/147>

 4. <https://clinicalgate.com/microbial-contamination-spoilage-and-preservation-of-medicines/>

02. Unit-II : 1.<http://textbookofbacteriology.net/control.html>

 2.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5468421/>

03. Unit -III: 1.<https://www.fda.gov/files/about%20fda/published/Pharmaceutical-Microbiology-Manual.pdf>

 2.<https://www.biooutsource.com/biosafety/assays/sterility-testing/?gclid=EAIaIQobChMI0cCN1YnU5wIVFamWCh13RQ85EAAYASAAEgK_CvD_BwE>

04. Unit-IV: 1.<http://jpdb.nihs.go.jp/jp14e/14data/General_Test/Microbial_Assay_for_Antibio.pdf>

05.Unit-V: 1. <https://www.drugs.com/article/antibiotics.html>

 2. <https://www.medicalnewstoday.com/articles/283963>

 3. [https://www.sigmaaldrich.com/life-science/biochemicals/biochemical- products.html?TablePage=14837959](https://www.sigmaaldrich.com/life-science/biochemicals/biochemical-products.html?TablePage=14837959)

 4.<https://amrls.cvm.msu.edu/pharmacology/antimicrobials/mode-of-action>

**PEDAGOGY:** Chalk and Talk, Powerpoint presentation.

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit –I (15 Hrs)  |
| 1.1 | Introduction to pharmaceutical microbiology | 2 | Lecture | Black Board |
| 1.2 | Scope of pharmaceutical microbiology | 2 | Lecture | Black Board |
| 1.3 | Antiseptics & their evaluation | 2 | Lecture | Black Board |
| 1.4 | chick Martin test and Rideal Walker test | 2 | Chalk & Talk | Black Board |
| 1.5 | Microbial contamination and spoilage of pharmaceutical products | 3 | Chalk & Talk | Black Board |
| 1.6 | sterile injectibles, noninjectibles | 2 | Chalk & Talk | Black Board |
| 1.7 | ophthalmic preparation & implants | 2 | Chalk & Talk | Black Board |
| Unit – II (15 Hrs) |
| 2.1 | Microbial control: Physical method heat, moist, cold, radiation. | 3 | Lecture | Black Board |
| 2.2 | Chemical method: disinfectants - methods, variants - alcohol, aldehyde, ethylene oxide. | 4 | Chalk & Talk | Black Board |
| 2.3 | Heavy metal, halogen, organic acid, oxidizing agents, phenol, surfactant. | 4 | Chalk & Talk | Black Board |
| 2.4 | Experimental parameters influencing the antimicrobial agent activity.  | 2 | Chalk & Talk | Black Board |
| 2.5 | Factors influencing activity of disinfectants. | 2 | Chalk & Talk | Black Board |
| Unit – III (15 Hrs)  |
| 3.1 |  Introduction to sterility testing of pharmaceutical products | 3 | Lecture | Black Board |
| 3.2 | Membrane filtration method | 3 | Lecture | Black Board |
| 3.3 | direct inoculation- nutrient broth, cooked meat medium. | 3 | Chalk & Talk | Black Board |
| 3.4 | Direct inoculation- sabouraud medium. | 3 | Chalk & Talk | Black Board |
| 3.5 | sampling probability profile | 3 | Chalk & Talk | Black Board |
| Unit- IV (15 Hrs) |
| 4.1 | Microbiological assays: Basic principle | 2 | Lecture | Black Board |
| 4.2 | Microbiological assays: Methodologies | 2 | Lecture | Black Board |
| 4.3 | Cylinder –plate and turbidometric method | 3 | Lecture | Black Board |
| 4.4 | Assay of antibiotics – chlorotetraucline | 3 | Chalk & Talk | Black Board |
| 4.5 | Assay of vitamin – Niacin | 3 | Chalk & Talk | Black Board |
| 4.6 | Assay of Amino acids. | 2 | Chalk & Talk | Black Board |
| Unit –V (15 Hrs)  |
| 5.1 | Classification of Antibiotics - Drug resistance of pathogens | 3 | Chalk & TalkLecture | Black Board |
| 5.2 | Mechanism of action of antibiotics- inhibitor of cell wall synthesis, nucleic acid and protein synthesis | 5 | Chalk & Talk | Black Board |
| 5.3 | Production of semi synthetic antibiotics | 3 | Chalk & Talk | Black Board |
| 5.4 | Derivatives of Penicillin | 4 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| --- | --- | --- | --- | --- | --- |
| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 1 | 2 | 2 |
| **CO2** | 2 | 3 | 1 | 2 | 3 |
| **CO3** | 2 | 3 | 3 | 1 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 1 |
| **CO5** | 2 | 3 | 3 | 1 | 2 |

3- STRONG 2 - MEDIUM 1 – LOW

**COURSE DESIGNER: Dr. T. SIVAGAMASUNDARI.**

**RESEARCH METHODOLOGY**

**SEMESTER V**

**Elective: II**

 **Code: 213003507/212903507**

**3Hrs/Week**

 **Credits 3**

 ***PREAMBLE***

* **To learn the techniques of microbial growth in controlled environments.**
* **To enable students to exploit the industrially important microorganisms.**
* **To gain about various types of fermentor and fermentation process**
* **To acquire knowledge on fermentation process of organic acids, vitamins and amino acids**

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

|  |  |  |
| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Develop familiarize with various kinds of research, objectives of doing research, research process, research designs and sampling. | Up to K3 |
| **CO 2** | To know the basic concept of research design and its various types | Up to K3 |
| **CO 3** | To frame the hypothesis, its types and to prepare a research report | Up to K3 |
| **CO 4** | To learn the essential basic techniques and to apply in research | Up to K3 |
| **CO 5** | Analyse the data through various statistical methods like measures of central tendency and measures of standard deviation | Up to K3 |

K1 - Knowledge K2 - Understanding K3 – Application

UNIT-I **[9 Hrs]**

Introduction – Research – Definition – Objectives – Types of research – Descriptive, Analytical, Applied, Qualitative. Quantitative, Conceptual, Empirical, Exploratory – Significance of research – Significance of research – Criteria for good research – Research process – Definition and steps of research process.

UNIT-II **[9 Hrs]**

Research design – Features of good research design – Experimental design – Informal, formal experimental designs (Brief account only) – Steps in sample design – Types of sample design – Non probability sampling, Probability sampling.

UNIT-III **[9 Hrs]**

Hypothesis – Definition – Characteristics of hypothesis – Concepts of hypothesis -Null and Alternate hypothesis – Levels of significance – Types of hypothesis – Type 1 and Type 2 – Research report – Components of research report – Steps in report writing – Role of computers in research

UNIT-IV **[9 Hrs]**

Principle and application of electrophoresis – NMR, X – Ray crystallography, Chromatography - Thin Layer Chromatography, High performance liquid Chromatography and FTIR.

UNIT-V **[9 Hrs]**

Data – Methods of collection and classification of data – Primary and Secondary data, representation of Data, Measures of central tendency: (Mean, Median and Mode) Measure of Dispersion, Standard Deviation, ANOVA – Table construction and uses.

**TEXT BOOKS:**

01. Kothari C.R., Research methodology, Willy Eastern Limited, New Delhi.

02. Gupta S.P., Statistical Methods, 9th Edition, S.Chand and Sons Publishers, New Delhi 1979.

03. Palanichamy.S and Manoharan. M, Statistical Methods for Biologists, Palani Paramount

**REFERENCE BOOKS:**

01. Keith Wilson and John Walkers, Principles and Techniques of Practical Bio-Chemistry, 5th Edition, Cambridge University press, USA, 2000.

02. Palanivelu P, Laboratory Manual for Analytical Bio – Chemisty and Separation Techniques 3rd Edition, 21st century Publications, 2002.

**WEB RESOURCES: (URLS)**

01. UNIT I:1.<https://www.slideshare.net/vaisalik/types-of-research>

02. UNIT II:1.<https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355/basic-principles-of-experimental-designs-11465.html>

03. UNIT III: 1.<https://www.wisdomjobs.com/e-university/research-methodology-tutorial-355/what-is-a-hypothesis-11523.html>

0.4 UNIT IV:1.<https://courses.lumenlearning.com/suny-hccc-research-methods/chapter/chapter-4-theories-in-scientific-research/>

0.5 UNIT V: 1.<https://courses.lumenlearning.com/suny-hccc-research-methods/chapter/chapter-4-theories-in-scientific-research/>

2.<https://courses.lumenlearning.com/atd-bmcc-sociology/chapter/approaches-to-sociological-research/>

**PEDAGOGY:** Chalk and Talk, video clip presentation

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit – I [9 Hrs] |
| 1.1 | Introduction – Research – Definition – Objectives | 2 | Lecture | Black Board |
| 1.2 | Types of research – Descriptive, Analytical, Applied, Qualitative. Quantitative, Conceptual, Empirical, Exploratory | 3 | Lecture | Black Board |
| 1.3 | Significance of research – Criteria for good research | 2 | Lecture | Black Board |
| 1.4 | Research process – Definition and steps of research process. | 2 | Chalk & Talk | Black Board |
| Unit – II [9 Hrs] |
| 2.1 | Research design – Features of good research design | 2 | Lecture | Black Board |
| 2.2 | Experimental design – Informal, formal experimental designs (Brief account only) | 2 | Chalk & Talk | Black Board |
| 2.3 | Steps in sample design | 2 | Chalk & Talk | Black Board |
| 2.4 | Types of sample design – Non probability sampling, Probability sampling. | 3 | Chalk & Talk | Black Board |
| Unit – III [9 Hrs]  |
| 3.1 | Hypothesis – Definition – Characteristics of hypothesis | 1 | Lecture | Black Board |
| 3.2 | Concepts of hypothesis -Null and Alternate hypothesis | 2 | Lecture | Black Board |
| 3.3 | Levels of significance – Types of hypothesis – Type 1 and Type 2 | 2 | Chalk & Talk | Black Board |
| 3.4 | Research report – Components of research report – Steps in report writing | 3 | Chalk & Talk | Black Board |
| 3.5 | Role of computers in research | 1 | Chalk & Talk | Black Board |
| Unit – IV [9 Hrs] |
| 4.1 | Principle and application of electrophoresis | 2 | Lecture | Black Board |
| 4.2 | NMR, X – Ray crystallography | 3 | Lecture | Black Board |
| 4.3 | Chromatography - Thin Layer Chromatography, High performance liquid Chromatography | 3 | Lecture | Black Board |
| 4.4 | FTIR. | 1 | Chalk & Talk | Black Board |
| Unit – V [9 Hrs]  |
| 5.1 | Data – Methods of collection and classification of data – Primary and Secondary data, | 3 | Chalk & TalkLecture | Black Board |
| 5.2 | Measures of central tendency: (Mean, Median and Mode) | 3 | Chalk & Talk | Black Board |
| 5.3 | Measure of Dispersion, Standard Deviation, | 2 | Chalk & Talk | Black Board |
| 5.4 | ANOVA – Table construction and uses. | 1 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| --- | --- | --- | --- | --- | --- |
| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 1 | 1 | 1 |
| **CO2** | 1 | 2 | 3 | 1 | 3 |
| **CO3** | 3 | 1 | 2 | 1 | 1 |
| **CO4** | 1 | 1 | 2 | 3 | 1 |
| **CO5** | 3 | 1 | 1 | 1 | 3 |

3 - STRONG 2 - MEDIUM 1 – LOW

**COURSE DESIGNER: Mr.G.PONNUDURAI**

**BIOINSTRUMENTATION**

**SEMESTER V**

**Elective-II Code: 213003508/ 212903508**

 **3 Hrs/Week**

 **Credits 3**

***PREAMBLE:***

* ***To make students able to handle various instruments properly.***
* ***To teach students, basic principle behind working of each instrument.***
* ***To make students know advance techniques useful in identification and purification of compounds.***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

|  |  |  |
| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Understand the technical aspects in the basic laboratory instrumentation techniques.  | Up to K3 |
| **CO 2** | Depict the knowledge on principle and applications of different chromatographic techniques and microscopic analysis. | Up to K3 |
| **CO 3** | Get detailed knowledge on electrophoretic techniques.. | Up to K3 |
| **CO 4** | Acquire knowledge on spectroscopic techniques and their applications. | Up to K3 |
| **CO 5** | Perform and analyse the knowledge on radioisotopic techniques.. | Up to K3 |

 K1 - Knowledge K2 - Understanding K3 – Application

Unit –I **[9 Hrs]**

Basic laboratory Instruments -Principle and working of pH meter, Laminar-air flow. Biosafety cabinets. Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications. Introduction to PCR, Gel documentation.

Unit – II **[9 Hrs]**

Chromatographic techniques and Microscopy**-**Theory, principles and applications of paper, thin layer, HPTLC, gel filtration, ion-exchange, affinity, hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC),

Microscopy – Dark Field and Phase contrast, Fluorescent, Electron, Atomic force microscopy.

Unit – III **[9 Hrs]**

Electrophoretic techniques -Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing, capillary, microchip and 2 D electrophoresis.

Unit – IV **[9 Hrs]**

Spectroscopy - Spectroscopic techniques, theory and applications of turbidometry, nephlometry, luminometry, UV-Visible, IR, NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.

Unit – V **[9 Hrs]**

Radioisotopic techniques - Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications. Dosimetry.

**TEXT BOOKS:**

01. Biochemistry. 6th Edition by Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Freeman, New York.

02. Bioinstrumentation, L.Veerakumari,1st Edition, Mjp Publications,2011.

**REFERENCE BOOKS:**

01. Biochemistry. 3rd edition by Garrett, R. H. and Grisham, C. M. (2004). Brooks/Cole, Publishing Company, California.

02. Principles and Techniques of Biochemistry and Molecular Biology by Wilson Keith and Walker John (2005), 6th Ed. Cambridge University Press, New York.

**WEB RESOURCES: (URLs)**

01. Unit-I

1.<https://microbenotescom.webpkgcache.com/doc//s/microbenotes.com/instrumentsusedinmicrobiologylab/>

2.<https://www.labcompare.com/ClinicalDiagnostics/5140MicrobiologyEquipment/>

02. Unit-II

1.[https://www.khanacademy.org/science/class11chemistryindia/xfbb6cb8fc2bd00c8:ininorganicchemistrysomebasicprinciplesandtechniques/xfbb6cb8fc2bd00c8:ininmethodofpurificationoforganiccompounds/a/principlesofchromatography](https://www.khanacademy.org/science/class11chemistryindia/xfbb6cb8fc2bd00c8%3Aininorganicchemistrysomebasicprinciplesandtechniques/xfbb6cb8fc2bd00c8%3Aininmethodofpurificationoforganiccompounds/a/principlesofchromatography)

2.<https://www.sciencedirect.com/topics/earthandplanetarysciences/microscopy>

03. Unit-III

1.<https://microbiologynotes.org/electrophoresisoverviewprinciplesandtypes/>

2.<https://www.thoughtco.com/electrophoresisdefinition4136322>

04. Unit- IV

1.[https://www.sciencedirect.com/topics/earth-and-planetary sciences/spectroscopy](https://www.sciencedirect.com/topics/earth-and-planetary%20sciences/spectroscopy)

2.<https://www.slideshare.net/LOKESHPANIGRAHI/spectroscopy134933430>

05. Unit-V

1.<https://www.britannica.com/science/radioactiveisotope>

2.[https://www.slideshare.net/abhigiri02/radioisotope-technique-and methods](https://www.slideshare.net/abhigiri02/radioisotope-technique-and%20methods)

**PEDAGOGY:**  Chalk and Talk, Power point presentation

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -1 [9Hrs] |
| 1.1 |  Basic laboratory Instruments -Principle and working of pH meter, Laminar-air flow. Biosafety cabinets.  | 2 | Lecture | Black Board |
| 1.2 | Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, | 2 | Lecture | Black Board |
| 1.3 | sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications. | 3 | Lecture | Black Board |
| 1.4 | Introduction to PCR, Gel documentation. | 2 | Chalk & Talk | Black Board |
| Unit -2[9Hrs] |
| 2.1 | Chromatographic techniques Theory, principles and applications of paper, thin layer,  | 2 | Lecture | Black Board |
| 2.2 | HPTLC, gel filtration, ion-exchange, affinity, | 1 | Chalk & Talk | Black Board |
| 2.3 | hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC), | 2 | Chalk & Talk | Black Board |
| 2.4 | Microscopy – Dark Field and Phase contrast, Fluorescent, | 2 | Chalk & Talk | Black Board |
| 2.5 | Electron, Atomic force microscopy | 2 | Chalk & Talk | Black Board |
| Unit – 3 [9Hrs] |
| 3.1 | Electrophoretic techniques -Basic principles of electrophoresis, theory and application  | 3 | Lecture | Black Board |
| 3.2 | paper, starch gel, agarose, native and denaturing PAGE | 3 | Lecture | Black Board |
| 3.3 | isoelectric focusing, capillary, microchip and 2 D electrophoresis. | 3 | Chalk & Talk | Black Board |
| Unit- 4 [9Hrs] |
| 4.1 | Spectroscopy - Spectroscopic techniques, theory and applications  | 2 | Lecture | Black Board |
| 4.2 | turbidometry, nephlometry, luminometry, UV-Visible | 2 | Lecture | Black Board |
| 4.3 | IR, NMR, Fluorescence, Atomic Absorption | 3 | Lecture | Black Board |
| 4.4 | CD, ORD, Mass, Raman Spectroscopy | 2 | Chalk & Talk | Black Board |
| Unit -5 [9Hrs]  |
| 5.1 | Radioisotopic techniques - Use of radioisotopes in life sciences. | 1 | Chalk & TalkLecture | Black Board |
| 5.2 | radioactive labeling, principle and application of tracer techniques, detection and measurement | 2 | Chalk & Talk | Black Board |
| 5.3 | radioactivity using ionization chamber, proportional chamber | 2 | Chalk & Talk | Black Board |
| 5.4 | Geiger- Muller and Scintillation counters | 2 | Chalk & Talk | Black Board |
| 5.5 | autoradiography and its applications. Dosimetry | 2 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 2 |  1  |  2 | 2 | 3 |
| **CO2** | 3 | 2 | 3 | 1 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 1 |
| **CO4** | 3 | 3 | 1 | 2 | 3 |
| **CO5** | 3 | 1 | 3 | 2 | 2 |

3 - STRONG 2 - MEDIUM 1 – LOW

**COURSE DESIGNER: Mr. G. PONNUDURAI**

**Self Learning Course–Major PROTEOMICS Code:218003530**

 **SEMESTER V Addl. Credits 4**

***PREMEABLE:-***

* ***To develop skills of the students in the area of proteome analysis .***
* ***To know about the various tools of proteomics***

UNIT – I:

Proteomics – Introduction types and scope, Concepts of proteome analysis – Identification of post translational modifications: phosphorylation, Glycosylation, Acetylation - Protein – protein interactions – Yeast two hybrid system.

UNIT – II:

Protein separation techniques: Ion – exchange, Size – exclusion, affinity Chromatography. Isoelectric focusing (IEF) , Two dimensional PAGE for proteome analysis.

UNIT – III:

Introduction to mass Spectrometry Fundamental Parameters: Mass accuracy, Resolution, Sensitivity, Ion source: Strategies for protein identification – protein sequencing – proteome database. Computational approaches to analyse protein.

UNIT – IV:

Gel based proteomics, LC- based proteomics, Tandem mass Spectrometry, Collision induced dissociation, Electron transfer dissociation, Data – Dependent MS / MS.

UNIT –V

Clinical and biomedical application of proteomics – Applications of proteome analysis to drug designing. 3D Conformation of a Protein molecule, Protein ligand docking.

**TEXT BOOKS**:

01. Andrew J., and Link L.D., Proteome Analysis Protocols, Human Press, New Jensey,1998.

**COURSE DESIGNER: Mr.L.ARULYESUDOSS**

**AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY**

**Core Subject Code: 213003601 5Hrs/Week**

 **Credits 4**

**PREAMBLE:**

* ***To acquire knowledge on basics in soil microbiology***
* ***To get theoretical background in biogeochemical cycles***
* ***To familiarize the applications of microbiology in environment***
* ***To obtain the solution to solve environmental problem through microbiological process***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Explain about various biogeochemical cycle, microbes involvement of biochemical mechanisms of carbon, nitrogen, phosphorous, sulphur | Up to K3 |
| **CO 2** | Describe the molecular mechanism of nitrogen fixation and types of mycorrhizae. | Up to K3 |
| **CO 3** | Identify the disease establishment in plant protection, plant pathogens and its control measures. | Up to K3 |
| **CO 4** | Develop the practical skills for conducting experiment to assess the portability of drinking water to control the pollutions. | Up to K3 |
| **CO 5** | Disseminate knowledge of microorganisms that play vital role in maintaining healthy environment by biodegradation of xenobiotic, phytoremediation, biogas etc., | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 - APPLICATION

UNIT I **[15 Hrs]**

Agricultural microbiology – Physical and Chemical properties of soil; Soil structure; Factors influencing soil microflora; Rhizosphere; Phyllosphere; Microbial interactions – Symbiosis, mutualism, commensalism, ammensalism, parasitism; Role of microorganisms in Biogeochemical cycle– Carbon, nitrogen, phosphorus and sulphur.

UNIT II **[15 Hrs]**

Role of microorganism in soil fertility; Biofertilizer -Nitrogen fixation – types- molecular mechanism and regulation of symbiotic nitrogen fixation; Mycorrhizae – types – ecto and endomycorrhizae; phosphate solublization

UNIT III **[15 Hrs]**

Disease establishment in plant- mechanism of plant protection (physical and chemical) – plant pathogens – Bacteria (Xanthomonas sp.) – Fungus (Fusarium sp.) – Virus(TMV); control of plant pathogens – Physical, chemical and biological methods.

UNIT IV **[15 Hrs]**

Microorganism in water – Freshwater and Marine ecosystem; Sources of water pollution –Industrial effluents and Domestic waste, Pollution indicator microorganisms; Assessment of microbiological quality of drinking water; Waste water treatment – Municipal waste water treatment – Primary, Secondary(biological) and Tertiary treatment – Eutrophication.

UNIT V **[15 Hrs]**

Solid waste management – Sanitary land filling, composting – Vermicomposting; Production of Biogas; Bioremediation – In situ and ex situ bioremediation; Phytoremediation; Biodegradation of xenobiotics (Hydrocarbon) – Bioleaching.

**TEXT BOOKS:**

01. Ronald M. Atlas and Richard Bartha, Microbial Ecology- Fundamentals and Applications, 4th edition, The Benjamin Cummins Publication Co. Inc.

02. Rengaswami, G. and Bagyaraj, D.J., Agricultural Microbiology (1998), 2nd  edition, Prentice. Hall of India pvt ltd., New Delhi.

03. Mishra, R.R., Soil Microbiology (1996), CBS publishers & distributers, New Delhi.

04. Ramanathan, N and Muthukaruppan, S.M. (2005) A text book of Environmental Microbiology. Om Sakthi Pathipagam, Annamalai Nagar.

**REFERENCE BOOKS:**

01. Subbarao, N.S.Advances in Agricultural microbiology (studies in the Agricultural & food sciences), 1998,Butterworth – Heinemann ltd

02. Samuel L.Tisdale,Werner L. Nelson, James D. Beaton and John L. Hartin, Soil fertility and fertilizers (1997), 5th edition, Prentice. Hall of India pvt ltd., New Delhi.

03. Prescott L.M, Harley J.P. & Klein D.A., Microbiology(2006), 6th edition, McGraw Hill Publishers.

04. Vyas, S.C., Smritivyas, Sammeervyas and H.A. Modi, Biofertilizers and Organic farming(1998), Aktaprakashan educational publishers, Nadiad.

05. Joseph C.Daniel, Environmental aspects of micriobiology (1996), Brightsun publications, Chennai.

**WEB RESOURCES: (URLs)**

01. UNIT I:

1. <https://courses.lumenlearning.com/microbiology/chapter/biogeochemical-cycles/>

2. <https://www.onlinebiologynotes.com/microbial-interaction-and-types-mutualism-syntropism-proto-cooperation-commensalism-antagonism-parasitism-predation-competition/>

02. UNIT II:1. <http://www.biologydiscussion.com/plant-physiology-2/nitrogen-metabolism/biochemistry-of-nitrogen-fixation-with-diagram/25851>

03. UNIT III:1. <https://courses.lumenlearning.com/boundless-biology/chapter/plant-defense-mechanisms/>

04. UNIT IV:1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/aquatic-microbiology/sewage-and-wastewater-treatment>,

05. UNIT V:1. <https://microbenotes.com/bioremediation/>, 2.<https://byjus.com/biology/vermicomposting/>

**PEDAGOGY:** Chalk and Talk, Power point presentation

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I [15 Hrs] |
| 1.1 | Agricultural microbiology – Physical and Chemical properties of soil  | 2 | Lecture | Black Board |
| 1.2 | Soil structure; Factors influencing soil microflora  | 2 | Lecture | Black Board |
| 1.3 | Factors influencing rhizosphere and Phyllosphere; | 2 | Lecture | Black Board |
| 1.4 | Microbial interactions – Symbiosis, mutualism,  | 2 | Chalk & Talk | Black Board |
| 1.5 | Microbial interactions – Commensalism, ammensalism, and parasitism | 2 | Chalk & Talk | Black Board |
| 1.6 | Role of microorganisms in Biogeochemical cycle– Carbon and nitrogen | 3 | Chalk & Talk | Black Board |
| 1.7 | Biogeochemical cycle - Phosphorus and sulphur  | 2 | Chalk & Talk | Black Board |
| Unit - II [15 Hrs] |
| 2.1 | Role of microorganism in soil fertility  | 2 | Lecture | Black Board |
| 2.2 | Biofertilizer -Nitrogen fixation – types  | 3 | Chalk & Talk | Black Board |
| 2.3 | Molecular mechanism and regulation of symbiotic nitrogen fixation | 4 | Chalk & Talk | Black Board |
| 2.4 | Mycorrhizae – types – ecto and endomycorrhizae; | 3 | Chalk & Talk | Black Board |
| 2.5 | Phosphate solublization | 3 | Chalk & Talk | Black Board |
| Unit - III [15 Hrs] |
| 3.1 | Disease establishment in plant | 2 | Lecture | Black Board |
| 3.2 | Mechanism of plant protection (physical and chemical)  | 3 | Lecture | Black Board |
| 3.3 | Plant pathogens – Bacteria (Xanthomonas sp.)  | 3 | Chalk & Talk | Black Board |
| 3.4 | Fungus (Fusarium sp.) | 2 | Chalk & Talk | Black Board |
| 3.5 | Virus(TMV) | 2 | Chalk & Talk | Black Board |
| 3.6 | Control of plant pathogens – Physical, chemical and biological methods. | 3 | Chalk & Talk | Black Board |
| Unit - IV [15 Hrs] |
| 4.1 | Microorganism in water – Freshwater and Marine ecosystem | 2 | Lecture | Black Board |
| 4.2 | Sources of water pollution –Industrial effluents and Domestic waste | 3 | Lecture | Black Board |
| 4.3 | Pollution indicator microorganisms; Assessment of microbiological quality of drinking water | 3 | Lecture | Black Board |
| 4.4 | Waste water treatment – Municipal waste water treatment  | 2 | Chalk & Talk | Black Board |
| 4.5 | Primary, Secondary(biological) and Tertiary treatment  | 3 | Chalk & Talk | Black Board |
| 4.6 | Eutrophication. | 2 | Chalk & Talk | Black Board |
| Unit - V [15 Hrs] |
| 5.1 | Solid waste management – Sanitary land filling | 3 | Chalk & TalkLecture | Black Board |
| 5.2 | Composting and Vermicomposting;  | 3 | Chalk & Talk | Black Board |
| 5.3 | Production of Biogas | 3 | Chalk & Talk | Black Board |
| 5.4 | Bioremediation – In situ and ex situ bioremediation; Phytoremediation | 3 | Chalk & Talk | Black Board |
| 5.5 | Biodegradation of xenobiotics (Hydrocarbon) – Bioleaching | 3 | Chalk & Talk | Black Board |

**MAPPING OF COS WITH POS**

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| **POs****Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 2 | 1 | 3 | 2 | 2 |
| **CO2** | 3 | 2 | 1 | 2 | 3 |
| **CO3** | 2 | 3 | 1 | 2 | 3 |
| **CO4** | 2 | 3 | 2 | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | 2 |

3 - STRONG 2- MEDIUM 1 - LOW

**COURSE DESIGNER: Dr. M. DHANASEKARAN**

**Core Subject INDUSTRIAL MICROBIOLOGY Code: 213003602**

**SEMESTER VI**

 **5 Hrs/Week Credits 4**

 **PREAMBLE:**

* **To learn the techniques of microbial growth in controlled environments.**
* **To enable students to exploit the industrially important microorganisms.**
* **To gain about various types of fermentor and fermentation process**
* **To acquire knowledge on fermentation process of organic acids, vitamins and amino acids**

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Develop an understanding of upstream process in fermentation industries and culture preservation techniques.  | Up to K3 |
| **CO 2** | Explain the design, types of fermentor, fermentation process and techniques of sterilization in industries.  | Up to K3 |
| **CO 3** | Acquire knowledge and understanding the concepts of downstream processing and recovery. | Up to K3 |
| **CO 4** | Understand the methods followed in the production of industrially important microbial primary and secondary metabolites. | Up to K3 |
| **CO 5** | Learn the processes involved in production of food substances like bread, cheese, yoghurt, pickles and enhance the efficiency of microorganisms to produce particular metabolite and produce the same at large scale. | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 – APPLICATION

UNIT – I: **[15 Hrs]**

General concepts of industrial microbiology. Scope and history of industrial microbiology.Media formulation.Screening of industrially important microrganisms. Strain improvement techniques. Preservation techniques.

UNIT – II: **[15 Hrs]**

An introduction to fermentor-Design and their types, Sterilization of fermentor, media and air. Types of fermentation- solid state fermentation - Batch, continuous and fed batch systems, Optimization of fermentation process. Methods of immobilization and application of immobilized enzymes/cells.

UNIT – III: **[15 Hrs]**

Introduction to down stream process- Separation of cell particles – centrifugation – precipitation – Filtration - Cell disruption – Extraction – product recovery – purification and concentration of products.

UNIT – IV: **[15 Hrs]**

Production of industrial products-Solvent-Ethyl alcohol, Antibiotics - Penicillin and streptomycin; Production of enzymes- Amylase and Proteases; Organic acid- Lactic acid and Acetic acid. Amino acid- L-Glutamic acid and L-lysine. Vitamins- Cyanocobalamine and β-carotene.

UNIT – V: **[15 Hrs]**

Microbes in production of food - bread, cheese, yoghurt, pickles, Production of alcoholic beverages - beer, wine, non-alcoholic beverages - tea and coffee. Beneficial Uses of Microorganisms in Food – Probiotics. Microbial cells as food – Single cell protein, mushrooms.

**TEXT BOOKS:**

01. Stanbury, P.F. and Whitaker, A.,(Eds). Principles of Fermentation Technology. 1984. Pergamon Press, Oxford.

02. Frazier, W.C. and Dennis, C. Westhoff. 1995 Food Microbiology, Tata McGraw Hill Publlishing Company, New Delhi.

03. Crueger W., and Crueger A., Biotechnology, Black-Well scientific publications, oxford, 1995.

04. Foster, WM , Food Microbiology. 2016. CBS Publishers & Distributors Pvt Ltd.

**REFERENCE BOOKS:**

01. Jackson, A.T . 1991. Process Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs, NJ, USA.

02. Enfors, S. O. and Haggstrom, L.H. 1998. Bioprocess Technology – Fundamentals and Application. KTH, Stockholm.

03. Aktinson B. 1974. Biochemical Reactors. Pion Ltd., London.

04. Pelczar M.J, Chang E.C.S and Krieg N. R . 1993. Microbiology-concepts and applications, McGraw Hill Company.

**WEB RESOURCES: (URLs)**

01. Unit 1:1. <https://run.edu.ng/directory/oermedia/422231995398.pdf>.

 2. <https://www.slideshare.net/kruti495/isolation-and-preservation-of-pure-baterial-culture>.

02. Unit 2: 1. <http://www.biologydiscussion.com/industrial-microbiology-2/fermentor-bioreactor-history-design-and-its-construction/55756>.

03. Unit 3:1. <https://www.slideshare.net/saileegurav/downstream-processing-30441992>.

04. Unit 4: 1.<https://www.slideshare.net/prachipatel96995/alcohol-fermentation>.

 2.<https://www.slideshare.net/MDCrules/enzymes-their-production>.

05. Unit 5: 1. <http://www.biologydiscussion.com/single-cell-protein/production-of-single-cell-protein-and-mushrooms/10392>.

 2. <https://www.slideshare.net/sheetalvincent/probiotics-13663177>.

**PEDAGOGY:** Chalk and Talk, Power point presentation.

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit –I (15 Hrs) |
| 1.1 | General concepts of industrial microbiology | 2 | Lecture | Black Board |
| 1.2 |  History of industrial microbiology | 2 | Lecture | Black Board |
| 1.3 | Scope of industrial microbiology | 2 | Lecture | Black Board |
| 1.4 | Media formulation | 2 | Chalk & Talk | Black Board |
| 1.5 | Screening of industrially important microrganisms. | 3 | Chalk & Talk | Black Board |
| 1.6 | Strain improvement techniques | 2 | Chalk & Talk | Black Board |
| 1.7 | Culture preservation techniques. | 2 | Chalk & Talk | Black Board |
| Unit –II (15 Hrs) |
| 2.1 | An introduction to fermentor-Design and their types. | 3 | Lecture | Black Board |
| 2.2 | Sterilization of fermentor, media and air. | 3 | Chalk & Talk | Black Board |
| 2.3 | Types of fermentation- solid state fermentation - Batch, continuous and fed batch systems. | 4 | Chalk & Talk | Black Board |
| 2.4 | Optimization of fermentation process. | 2 | Chalk & Talk | Black Board |
| 2.5 | Methods of immobilization and application of immobilized enzymes/cells. | 3 | Chalk & Talk | Black Board |
| Unit – III (15 Hrs)  |
| 3.1 | Introduction to down stream process. | 2 | Lecture | Black Board |
| 3.2 | Separation of cell particles | 2 | Lecture | Black Board |
| 3.3 | centrifugation , precipitation and Filtration | 2 | Chalk & Talk | Black Board |
| 3.4 | Cell disruption and Extraction | 2 | Chalk & Talk | Black Board |
| 3.5 | Chromatographic techniques | 2 | Chalk & Talk | Black Board |
| 3.6 | product recovery  | 2 | Chalk & Talk | Black Board |
| 3.7 | product recovery – purification and concentration of products. | 3 | Chalk & Talk | Black Board |
| Unit – IV (15 Hrs)  |
| 4.1 | Production of industrial products-Solvent-Ethyl alcohol. | 2 | Lecture | Black Board |
| 4.2 | Antibiotics - Penicillin and streptomycin. | 2 | Lecture | Black Board |
| 4.3 | Production of enzymes- Amylase and Proteases. | 3 | Lecture | Black Board |
| 4.4 | Production of Organic acid- Lactic acid and Acetic acid | 3 | Chalk & Talk | Black Board |
| 4.5 | Production of Amino acid- L-Glutamic acid and L-lysine. | 2 | Chalk & Talk | Black Board |
| 4.6 | Production of Vitamins- Cyanocobalamine and β-carotene | 3 | Chalk & Talk | Black Board |
| Unit –V (15 Hrs)  |
| 5.1 | Microbes in production of food - bread, cheese. | 2 | Chalk & TalkLecture | Black Board |
| 5.2 | Microbes in production of food - yoghurt, pickles. | 2 | Chalk & Talk | Black Board |
| 5.3 | Production of alcoholic beverages - beer, wine. | 2 | Chalk & Talk | Black Board |
| 5.4 | Production of non-alcoholic beverages - tea and coffee. | 2 | Chalk & Talk | Black Board |
| 5.5 | Beneficial Uses of Microorganisms in Food – Probiotics | 3 | Chalk & Talk | Black Board |
| 5.6 | Microbial cells as food – Single cell protein, mushrooms. | 4 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 |  3 | 2 | 1 |
| **CO2** | 2 | 3 | 1 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 1 | 2 |
| **CO4** | 2 | 3 | 1 | 2 | 3 |
| **CO5** | 3 | 2 | 2 | 3 | 3 |

3 - STRONG 2 - MEDIUM 1 - LOW

**COURSE DESIGNER: Dr. T. SIVAGAMASUNDARI**

**Core Subject FOOD MICROBIOLOGY Code: 213003603**

 **SEMESTER VI**

 **5Hrs/Week**

 **Credits 4**

**PREAMBLE:**

* **To learn the techniques of microbial growth in controlled environments.**
* **To enable students to exploit the industrially important microorganisms.**
* **To gain about various types of fermentor and fermentation process**
* **To acquire knowledge on fermentation process of organic acids, vitamins and amino acids**

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on microbial growth in foods.  | Up to K3 |
| **CO 2** | Ascertain the different types of microorganisms in vegetables, fruits, meat, eggs, milk, etc., and their activities. | Up to K3 |
| **CO 3** | Demonstrate the principles underlying the physical and chemical preservation methods through practices. | Up to K3 |
| **CO 4** | Appreciate how microbiology is applied in manufacture of different types of fermented foods – yogurt, cheese, kumiss, dosa, etc., and their applications as probiotics. | Up to K3 |
| **CO 5** | Recognize and describe the characteristics of important food borne pathogens, foods involved, symptoms and preventive measures. | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 – APPLICATION

UNIT-I: **[15Hrs]**

 Microbiology of food: Food as substrate: Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

UNIT-II: **[15Hrs]**

 Microbial spoilage of various food products: Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

UNIT-III: **[15Hrs]**

 Methods of food preservation: Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation - chemical methods of food preservation: salt, sugar, organic acids, SO2 and bacteriocins

UNIT-IV: **[15Hrs]**

Fermented foods: Dairy products - yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce. Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

UNIT-V: **[15Hrs]**

Food borne diseases (causative agents, foods involved, symptoms and preventive measures): Food intoxications: *Staphylococcus aureus, Clostridium botulinum* and mycotoxins; Food infections: *Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli,* Salmonellosis, Shigellosis*.*

**TEXT BOOKS:**

01. James M. Jay, Modern Food Microbiology, An Aspen Publications, Gaithersburg, Maryland, 2005, sixth edition.

02. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

03. Frazier WC and Westhoff DC. (2008). Food Microbiology. 4rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

04. Shirley J.VanGarde , Margy Woodburn Food Presevation and Safety (2005), Reprint Jagrati, Delhi.

**REFERENCE BOOKS:**

01. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

02. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

03. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

04. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.

05. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.

**WEB RESOURCES: (URLs)**

01.Unit 1:1. <https://www.slideshare.net/davidmbwiga1990/lecture-3-intrinsic-and-extrinsic-factors>.

 2. [https://www.foodsafety.com.au/resources/articles/food-safety-and-the-different-types-of-food- contamination](https://www.foodsafety.com.au/resources/articles/food-safety-and-the-different-types-of-food-%20contamination).

02. Unit 2: 1. <https://www.slideshare.net/chandrima95/microbial-spoilage-of-fruits-and-vegetables>.

03.Unit3:1.<https://www.cds.hawaii.edu/kahana/downloads/curriculum/SectionII/Unit3/3.C.MeaaiaFoodScience/3.C.3.FoodPreservationMethods.pdf>.

2. <https://www.slideshare.net/pramodkumarsikarawar/food-preservation-66624992>.

04. Unit 4: 1. <https://www.slideshare.net/sheetalvincent/probiotics-13663177>.

 2. <https://www.slideshare.net/vpvsingh/fermented-food-products>.

05. Unit 5: 1.<https://www.slideshare.net/JofredMartinez/foodborne-diseases-72038336>.

**PEDAGOGY:** Chalk and Talk, Power point presentation

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

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| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I (15 hrs)  |
| 1.1 | Microbiology of food | 2 | Lecture | Black Board |
| 1.2 | Food as substrate: Intrinsic factors | 3 | Lecture | Black Board |
| 1.3 | Food as substrate: extrinsic factors | 3 | Lecture | Black Board |
| 1.4 | Factors that affect growth and survival of microbes in foods | 5 | Chalk & Talk | Black Board |
| 1.5 | natural flora and source of contamination of foods in general | 5 | Chalk & Talk | Black Board |
| Unit -II (15 hrs)  |
| 2.1 | Microbial spoilage of various food products | 3 | Lecture | Black Board |
| 2.2 | Principles of Microbial spoilage of various food products | 3 | Chalk & Talk | Black Board |
| 2.3 | Spoilage of vegetables and fruits | 3 | Chalk & Talk | Black Board |
| 2.4 | Spoilage of meat, eggs | 3 | Chalk & Talk | Black Board |
| 2.5 | Spoilage of milk and butter | 3 | Chalk & Talk | Black Board |
| 2.6 | Spoilage of bread, canned Foods | 3 |  |  |
| Unit – III (15 hrs) |
| 3.1 | Methods of food preservation | 1 | Lecture | Black Board |
| 3.2 | Food preservation Principles | 2 | Lecture | Black Board |
| 3.3 | Methods of food preservation - physical method- temperature (low, high, canning, drying) | 6 | Chalk & Talk | Black Board |
| 3.4 | Methods of food preservation - irradiation | 4 | Chalk & Talk | Black Board |
| 3.5 | Methods of food preservation – chemical methods - salt, sugar, organic acids, SO2 and bacteriocins | 5 | Chalk & Talk | Black Board |
| Unit – IV (15 hrs)  |
| 4.1 | Fermented foods: Dairy products  | 2 | Lecture | Black Board |
| 4.2 | Fermented foods: Dairy products - yogurt, acidophilus milk | 4 | Lecture | Black Board |
| 4.3 | Fermented foods: Dairy products - kumiss, kefir, dahi and cheese | 5 | Lecture | Black Board |
| 4.4 | Fermented foods: dosa, sauerkraut, soy sauce | 4 | Chalk & Talk | Black Board |
| 4.5 | Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market | 3 | Chalk & Talk | Black Board |
| Unit -V (15 hrs)  |
| 5.1 | Food borne diseases  | 2 | Chalk & TalkLecture | Black Board |
| 5.2 | Food borne diseases (causative agents, foods involved, symptoms and preventive measures) *Staphylococcus aureus, Clostridium botulinum* | 5 | Chalk & Talk | Black Board |
| 5.3 | Food borne diseases (causative agents, foods involved, symptoms and preventive measures)- Food intoxications and mycotoxins | 4 | Chalk & Talk | Black Board |
| 5.4 | Food infections- *Bacillus cereus, Vibrio parahaemolyticus* | 3 | Chalk & Talk | Black Board |
| 5.5 | Food infections - *Escherichia coli,* Salmonellosis, Shigellosis | 4 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 2 | 1 | 1 | 2 | 1 |
| **CO2** | 3 | 1 | 2 | 1 | 1 |
| **CO3** | 2 | 3 | 2 | 3 | 1 |
| **CO4** | 3 | 3 | 1 | 3 | 2 |
| **CO5** | 3 | 1 | 1 | 2 | 3 |

3 - STRONG 2 - MEDIUM 1 – LOW

**COURSE DESIGNER: Mr. T. MUTHURAYAR**

**Core Lab LAB IN AGRICULTURAL, FOOD AND INDUSTRIAL MICROBIOLOGY SEMESTER VI Code: 213003605**

 **3 Hrs/Week**

 **Credits 3**

**PREAMBLE:**

* ***To provide good platform on the applied aspects of microbiology.***
* ***To enrich the knowledge of students on current scenario of Industrial Microbiology.***

 **Agricultural Microbiology**

1. Isolation and mass cultivation of *Rhizobium* from leguminous nodules.
2. Isolation of Phytohormone (IAA) producing bacteria from soil
3. Isolation of biocontrol organisms – *Trichoderma/ Pseudomonas*
4. Isolation and screening of antibiotic producing microorganisms from soil.

**Food Microbiology**

1. Isolation of food borne pathogens on selective, differential and enriched medium by streak plating method.
2. Microbial examination of canned foods.
3. Enumeration of lactic acid bacteria from fermented foods.
4. Yogurt fermentation with *Lactobacillus* culture.

**Industrial Microbiology**

1. Immobilization of yeast cells in alginate bead.

 10. Production of wine.

 11. Determining the quality of milk by MBRT.

 12. Drinking water quality testing by MPN technique.

**TEXT BOOKS**:

01. Buchnan, B. B., Gruissem, W. and Jones, R. L., Biochemistry and molecular biology of plants. American Society for Plant Physiologists, Rockville, USA. 2000.

02. Laboratory Exercise in Microbiology – Harley Prescott, Fifth edition.

03. Microbial Applications, A Laboratory Manual in General Microbiology - Benson, Eighth edition.

04. Neelima Garg, K.L.Garg and Krishna G.Mukerji., Laboratory manual of food microbiology. I.K.International Pvt.Ltd. 2010.

**REFERENCE BOOKS:**

01. A.H. Patel, Industrial Microbiology –MacMillan Publishers, 2005.

02. Fermentation Microbiology: Making Cheese, Yogurt and Buttermilk as a lab exercise, Mary Anne Drake and John Mc Killip, 2000.

**COURSE DESIGNER: Dr.A.GANESH**

**Core Lab Lab in Bioinformatics Code:213003606/**

 **SEMESTER VI 212903606**

**2Hrs/Week**

 **Credits 2**

**PREAMBLE:**

* ***To learn the basic methodology in Bioinformatics***
* ***To develop technological tools that help analyze biological data****.*
* ***The program aims to utilize and understand biological databases to gather, store, retrieve, manage, analyze and integrate biological data for generating new knowledge.***

1. Bioinformatics Resources: NCBI, EMBL and DDBJ.

2. Database search engines : Entrez.

3. Open access bibliographic resources and literature databases.

 a. PubMed

 b. BioMed Central

4. Sequence databases:

a. Nucleic acid Sequence databases : GenBank, EMBL, DDBJ

 b. Protein Sequence database (PIR, SWISSPROT)

 c. Genome databases at NCBI, EBI.

5. Sequence File format:

 a. Pair wise Sequence alignment tool – BLAST and FASTA.

 b. Multiple sequence alignment tools - Clustal W.

6. Polygenetic tree construction using Mega 5.

7. Protein Structural database – PDB.

8. Molecular Visualization tool – RASMOL.

**REFERENCES:**

01. https://www.ncbi.nlm.nih.gov.

02. <https://www.megasoftware.net>

03. <http://www.openrasmol.org>

04. https://www.rcsb.org

**COURSE DESIGNER: Mr. L. ARUL YESUDOSS**

 **BIOINFORMATICS Code:213003607/212903607**

**Elective-III SEMESTER VI**

**3 Hrs/Week**

 **Credits 3**

 **PREAMBLE:**

* ***To learn about the basics and applications of bioinformatics and also know about database.***
* ***To understand the nucleic acid sequence and protein databases.***
* ***To acquire knowledge an Sequence alignment- Tools of Analysis and unknown nucleotide sequence and evolutionary relationships***
* ***To gain the knowledge of Structural classification of protein and phylogenetic analysis of protein.***
* ***To understand the gene prediction method and tools for gene prediction and also drug design****.*

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** | To learn about the basics and applications of bioinformatics and also know about database. | Up to K3 |
| **CO 2** | To understand the nucleic acid sequence and protein databases. | Up to K3 |
| **CO 3** | To acquire knowledge an Sequence alignment- Tools of Analysis and unknown nucleotide sequence and evolutionary relationships | Up to K3 |
| **CO 4** | To gain the knowledge of Structural classification of protein and phylogenetic analysis of protein. | Up to K3 |
| **CO 5** | To understand the gene prediction method and tools for gene prediction and also drug design. | Up to K3 |

K1 - KNOWLEDGE K2 - UNDERSTANDING K3 - APPLICATION

UNIT – I: **[9 Hrs]**

Bioinformatics - Definition, application and significance of bioinformatics in life sciences. Database- introduction, types and classification, internet, World Wide Web.

UNIT – II: **[9 Hrs]**

Nucleic acid sequence databases - Genbank, EMBL and DDBJ, Protein sequence databases – Protein Information Resource, SWISS PROT, protein structural databases – Protein Data Bank.

UNIT – III: **[9 Hrs]**

 Sequence alignment- Tools of Analysis - FASTA, BLAST, clustal W, protein visualization tools- SWISS PDB viewer, RasMol.

UNIT – IV:  **[9 Hrs]**

 Structural and classification of protein- SCOP, PROSITE and CATH, Phylogenetic analysis method - maximum parsimony, distance method.

UNIT – V: **[9 Hrs]**

Gene prediction- method and tools for gene prediction. Drug design – Structural and ligand based drug design, Lipinski rules - ADMET properties, Protein 3D structure prediction- Homology modeling - Ramachandran Plot.

**TEXT BOOKS**:

01. S. Ignacimuthu, Basic Bioinformatics, Narosa publishing house New Delhi, 2006

02. Rastogi S. C., Mendisatta N., Rastogi P., Bioinformatics methods and application, 3rd Edition, PHI learning private limited, New Delhi, 2008.

**REFERENCE BOOKS:**

01. David W. Mount, Bioinformatics sequence and Genome Analysis, University of Arizona, TUCSON, CBS Publishers, Bangalore, 2001.

02. T. K. Attwood, D.J. Parry –Smith. Introduction to bioinformatics - Pearson Education (Singapore Pvt Ltd), 1999.

**WEB RESOURCES (URLs):**

01. Unit I:

1. <https://en.wikipedia.org/wiki/Bioinformatics>

2. <https://en.wikipedia.org/wiki/Internet>

02. Unit II :

1.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3964972

2. <https://en.wikipedia.org/wiki/List_of_biological_databases>

03. Unit III:

1. <https://en.wikipedia.org/wiki/FASTA>

2. <https://blast.ncbi.nlm.nih.gov/Blast.cgi>

04. Unit IV:

1.<https://spdbv.vital-it.ch/>

2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3965108/>

05. Unit V:

1. <https://en.wikipedia.org/wiki/List_of_gene_prediction_software>

2. <https://en.wikipedia.org/wiki/Homology_modeling>.

**PEDAGOGY:** Chalk and Talk, Power point presentation, Animations

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I [9 Hrs] |
| 1.1 | Bioinformatics - Introduction, application and significance of bioinformatics in life sciences.  | 4 | Chalk & Talk | Black Board |
| 1.2 | Database- introduction, types and classification of databases  | 3 | Chalk & Talk | Black Board |
| 1.3 | Internet, World Wide Web. | 2 | Lecture | Power point presentation |
| Unit - II [9 Hrs] |
| 2.1 | Nucleic acid sequence databases - Genbank, EMBL and DDBJ | 4 | Chalk & Talk | Black Board |
| 2.2 | Protein sequence databases – Protein Information Resource, SWISS PROT | 3 | Chalk & Talk | Black Board |
| 2.3 | protein structural databases – Protein Data Bank.  | 2 | Chalk & Talk | Black Board |
| Unit - III [9 Hrs] |
| 3.1 | Sequence alignment- Tools of Analysis  | 2 | Chalk & Talk | Black Board |
| 3.2 | FASTA, BLAST, clustal W | 4 | Lecture | Power point presentation |
| 3.3 | Protein visualization tools- SWISS PDB viewer, RasMol. | 3 | Lecture | Power point presentation |
| Unit - IV [9 Hrs] |
| 4.1 | Structural and classification of protein | 2 | Chalk & Talk | Black Board |
| 4.2 | SCOP, PROSITE and CATH | 3 | Chalk & Talk | Black Board |
| 4.3 | Phylogenetic analysis method - maximum parsimony, distance method. | 4 | Chalk & Talk | Black Board |
| Unit - IV [9 Hrs] |
| 5.1 | Gene prediction- method and tools for gene prediction.  | 2 | Chalk & Talk | Black Board |
| 5.2 | Drug design – Structural and ligand based drug design, Lipinski rules - ADMET properties | 3 | Lecture | Power point presentation |
| 5.3 | Protein 3D structure prediction- Homology modeling  | 3 | Chalk & Talk | Black Board |
| 5.4 | Ramachandran Plot. | 1 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| **POs****COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 1 | 2 | 2 | 3 |
| **CO2** | 3 | 2 | 2 | 2 | 1 |
| **CO3** | 3 | 1 | 2 | 1 | 3 |
| **CO4** | 2 | 3 | 1 | 2 | 2 |
| **CO5** | 3 | 1 | 2 | 1 | 3 |

3 - STRONG 2 - MEDIUM 1 - LOW

**COURSE DESIGNER: Mr. L. ARUL YESUDOSS**

**Elective -III TRANSCRIPTOMICS AND METABOLOMICS**

 **SEMESTER VI Code:213003608/212903608**

**3 Hrs/Week**

 **Credits 3**

**PREAMBLE:**

* ***To know about existing and emerging application of transcriptomics studies.***
* ***To evaluate advantages and limitations of some analytical techniques used in transcriptomics and metabolomics studies***

**COURSE OUTCOMES (CO)**

On Successful completion of the course, the student will be able to

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| --- | --- | --- |
| **CO** | **Course Outcome** | **Knowledge Level (According to Bloom’s Taxonomy)** |
| **CO 1** |  Illustrate about types, regulation and importance of transcription | Up to K3 |
| **CO 2** | Depict the gene expression and transcriptomic analysis | Up to K3 |
| **CO 3** | Elucidate the basic principles and applications of transcriptome techniques | Up to K3 |
| **CO 4** | Point up the significance of metabolomics of plant and animal | Up to K3 |
| **CO 5** | Analyse the metabolites using various techniques like Mass spectroscopy, NMR etc., | Up to K3 |

K1 - KNOWLEDGE (REMEMBERING) K2 - UNDERSTANDING K3 - APPLICATION

UNIT – I: **[9 Hrs]**

 Introduction to transcript, transcriptome and transcriptomics. Importance of transcription. Types of transcripts. Generation of transcriptional regulatory networks. Databases and softwares for transciptomics study.

UNIT – II: **[9 Hrs]**

 Data mining and bioinformatics software to built transcription regulatory model. High throughput genetic manipulations, Denova transcriptome analysis, gene expression profiling, noncoding RNA discovery and deletion.

UNIT – III: **[9 Hrs]**

 Techniques of transciptome analysis: mRNA isolation, cDNA synthesis, semi- quantitative/ qPCR, microarray, EST, SAGE, dot-blot, Northern blotting. Comparative transcriptome analysis techniques- Suppression, substraction, hybridization.

UNIT – IV:  **[9 Hrs]**

 Introduction to metabolism, metabolites, metabolome and metabolomics- significance of metabolomics. Key metabolic pathways in plant and animals. Metabolic profiling in phenotyping and breeding – Arabdopsis, ecotype, rice, maize, potato.

UNIT – V: **[9 Hrs]**

 Principles and procedures of metabolites extraction: Mass spectroscopy, NMR, X ray crystallography, LIF, LC-UV, CE-MS, 2D and high resolution metabolic profiling. Metabolic pathway resources: KEGG, Biocarta. Future prospective of metabolomics.

**TEXT BOOKS:**

01. Attwood T. K and Parry Smith D.J., Introduction to Bioinformatics, Peasson Education, Asia, 1999.

02. Primrose Old R.W., and S. B., principles of gene manipulation, BLackWells Science, Inc 6th Rdition, Germany, 2002.

**REFERENCE BOOKS:**

01. Mark Schena, DNA microarrays: A Practical Approaches, Oxford University Press, Oxford England, 1999.

02. William M.R., Appel R.D., and Hrchstracsr D.F., Proteome Research: New Tronfiers in Functional Genomics: Principles and Practice, Springer Vetrlap, New York, 1997

**WEB RESOURCES (URLs):**

01. Unit – I

1.<https://nptel.ac.in/content/storage2/courses/102101007/downloads/PPT/LEC-03-PPT.pdf>

2.<https://nptel.ac.in/content/storage2/courses/102101007/downloads/TRANSCRIPT/LEC-03-TRANSCRIPT.pdf>

02. Unit–II

1.<https://www.ijcsmc.com/docs/papers/May2017/V6I5201729.pdf><https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0001717>

2.<https://www.eurofinsgenomics.eu/en/next-generation-sequencing/customised-solutions/transcriptome-sequencing/de-novo-transcriptome/>

03. Unit–III

1.<https://www.researchgate.net/publication/51667731_Transcriptome_Analysis/link/09e41502e227106162000000/download>

2.<https://www.researchgate.net/publication/303404667_RNA-Seq_methods_for_transcriptome_analysis_RNA-Seq>

04. Unit–IV

1.[https://www.cell.com/cell-metabolism/pdf/S1550-4131(07)00298-7.pdf](https://www.cell.com/cell-metabolism/pdf/S1550-4131%2807%2900298-7.pdf)<https://www.researchgate.net/publication/319677524_Metabolomics/link/5a40ebb10f7e9ba8689ee86c/download><https://web.stanford.edu/class/gene211/lectures/Lecture9_Metabolomics-Proteomics-2018.pdf>

05. Unit–V

1.<https://www.intechopen.com/books/molecular-medicine/metabolomics-basic-principles-and-strategies>

2.<https://www.researchgate.net/publication/329160885_Metabolomics_Resources_An_Introduction_of_Databases_and_Their_Future_Prospective>

**PEDAGOGY:**

Chalk and Talk, Power point presentation, Animations

**COURSE CONTENTS & TEACHING/LEARNING SCHEDULE**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module No.** | **Topic** | **No. of Lectures** | **Content Delivery Method** | **Teaching Aids** |
| Unit -I [9 Hrs] |
| 1.1 | Introduction to transcript, transcriptome and transcriptomics. Importance of transcription. | 3 | Chalk & Talk | Black Board |
| 1.2 | Types of transcripts. Generation of transcriptional regulatory networks.  | 3 | Chalk & Talk | Black Board |
| 1.3 | Databases and softwares for transciptomics study.  | 3 | Lecture | Power point presentation |
| Unit - II [9 Hrs] |
| 2.1 | Data mining and bioinformatics software to built transcription regulatory model.  | 3 | Chalk & Talk | Black Board |
| 2.2 | High throughput genetic manipulations, Denova transcriptome analysis | 3 | Chalk & Talk | Black Board |
| 2.3 | Gene expression profiling, noncoding RNA discovery and deletion. | 3 | Chalk & Talk | Black Board |
| Unit - III [9 Hrs] |
| 3.1 | Techniques of transciptome analysis: mRNA isolation, cDNA synthesis. | 3 | Chalk & Talk | Black Board |
| 3.2 | Semi- quantitative/ qPCR, microarray, EST, SAGE, dot-blot, Northern blotting.  | 3 | Lecture | Power point presentation |
| 3.3 | Comparative transcriptome analysis techniques- Suppression, substraction, hybridization. | 3 | Lecture | Power point presentation |
| Unit - IV [9 Hrs] |
| 4.1 | Introduction to metabolism, metabolites, metabolome and metabolomics- significance of metabolomics.  | 3 | Chalk & Talk | Black Board |
| 4.2 | Key metabolic pathways in plant and animals.  | 2 | Chalk & Talk | Black Board |
| 4.3 | Metabolic profiling in phenotyping and breeding – Arabdopsis, ecotype, rice, maize, potato. | 4 | Chalk & Talk | Black Board |
| Unit - V [9 Hrs] |
| 5.1 | Principles and procedures of metabolites extraction: Mass spectroscopy, NMR, X ray crystallography, LIF. | 3 | Chalk & Talk | Black Board |
| 5.2 | LC-UV, CE-MS, 2D and high resolution metabolic profiling. | 3 | Lecture | Power point presentation |
| 5.3 | Metabolic pathway resources: KEGG, Biocarta. Future prospective of metabolomics. | 3 | Chalk & Talk | Black Board |

**MAPPING OF COs WITH POs**

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| --- | --- | --- | --- | --- | --- |
| **POs****Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| **CO1** | 3 | 2 | 3 | 1 | 2 |
| **CO2** | 2 | 1 | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 1 | 2 | 3 |
| **CO5** | 1 | 3 | 2 | 3 | 1 |

3 – STRONG 2 – MEDIUM 1 – LOW

**COURSE DESIGNER: Mr. L. ARUL YESUDOSS**