Dhanalakshmi Srinivasan College of Arts & Science for Women
(Autonomous) (Affiliated to Bharathidasan University, Trichirappalli)
(Nationally Re-accredited with 'A' Grade by NAAC)
Course title Perambalur- 621 212
M.Sc MICROBIOLOGY COURSE UNDER CBCS

Sem	Course	Course Title	Sub.Code	Periods/ week	Credit	Exam hrs	Internal	External	Total
I	Core Course-I (CC)	General Microbiology	18PMB1C1	6	5	3	25	75	100
	Core Course-II (CC)	Microbial Metabolism	18PMB1C2	5	4	3	25	75	100
	Core Course-III (CC)	Microbial Biochemistry	18PMB1C3	5	4	3	25	75	100
	Core Course-IV(CC)	Practical's I-Pertaining CCI,CCII & CCIII	18PMB1C4P	6	3	6	40	60	100
	Elective Course-I (CE)	A)Pharmaceutical Microbiology	18PMB1E1A	5	4	3	25	75	100
		B)IPR and Bioethics	18PMB1E1B						
	Application Oriented Course	Bioinstrumentation	18PMB1A1	3	3	3	25	75	100
	Total			**30**	**23**				**600**
II	Core Course-(CC) V	Advanced virology	18PMB2C5	6	5	3	25	75	100
	Core Course-VI(CC)	Microbial Genetics	18PMB2C6	5	4	3	25	75	100
	Core Course-VII(CC)	Environmental and Agricultural Microbiology	18PMB2C7	5	5	3	25	75	100
	Core Course-VIII (CC)	Practicals II- Pertaining CCV,CC VI&CCVII	18PMB2C8P	6	3	6	40	60	100
	Elective Course-II(CE)	A)Marine Microbiology	18PMB2E2A	5	4	3	25	75	100
		B)Introductory Nanotechnology	19PMB2E2B						
	Application Oriented Course	Mushroom Technology	18PMB2A2	3	3	3	25	75	100
	Total			**30**	**24**				**600**
III	Core Course-IX (CC)	Immunology and Medical Microbiology	18PMB3C9	6	5	3	25	75	100
	Core Course-X(CC)	Microbial Food Technology	18PMB3C10	5	4	3	25	75	100
	Core Course-XI (CC)	Recombinant DNA Technology	18PMB3C11	6	5	3	25	75	100
	Core Course-XII (CC)	Practical III-Pertaining CCIX,CCX &CCXI	18PMB3C12P	8	5	6	40	60	100
	Elective Course-III (CE)	A) Fermentation Technology	18PMB3E3A	5	4	3	25	75	100
		B) Gene Technology	18PMB3E3B						
	Total			**30**	**23**				**500**
IV	Core Course-XIII(CC)	Research Methodology	18PMB4C13	6	5	3	25	75	100
		Project work	18PMB4PW	24	15	3	40	60	200
	Total			**30**	**20**				**300**
	Grand Total			**120**	**90**				**2000**

LIST OF ELETIVE COURSES FOR PG MICROBIOLOGY

I	P MBE101A	Pharmaceutical Microbiology
	P MBE101B	IPR and Bioethics
II	P MBE201A	Marine Microbiology
	P MBE201B	Introductory Nanotechnology
III	P MBE301A	Fermentation Technology
	P MBE301B	Gene Technology

CORE COURSE : I

GENERAL MICROBIOLOGY

Semester : I	**Max Marks : 75**
Course Code : 18PMB1C1	**Credit : 5***
Total Period : 75	**Exam Hrs : 3**

Objective

To provide the fundamental knowledge about the various scopes of microbiology and their concepts.

UNIT I Microbial origin (15 Period)

Origin of life - theories of origin of life - fossil evidence - introduction to evolution. Mechanism - the process of evolution-micro evolution - speciation - macro evolution. Evidence of evolution. Evolutionary theory – Lamarckism - Darwinism and natural selection. Neo Darwinism.

UNIT II Overview of Microbiology (12 Period)

Scope of microbiolgy, classification of microbes - systems of classification, numerical taxonomy, identifying characters for classification, general properties and principles of classification of microorganisms systematic of bacteria, nutritional types and classification.

UNIT III Sterilization and Staining (18 Period)

Physical and chemical methods of sterilization; disinfection sanitization, antisepsis, sterilants and fumigation. Stains and staining techniques- definition of auxochrome, chromophores, dyes, classification of stains, theories of staining, mechanism of gram staining, acid fast staining, negative staining , capsule staining , flagella staining and endospore staining.

UNIT IV Kingdom Fungi and Algae (14 Period)

General characteristics and outline classification of fungi by Alexopoulos (1979). Heterokaryon - dimorphic fungi and imperfcti fungi. Cell wall of fungi. Lifecycle of fungi- sexual and parasexuality. Alge - general characteristics, classification of algae by smith (1955). Nature of cell wall - pigmentation and photosynthetic apparatus. reproduction and characteristics of algae chlorophyta (Green algae), diatoms, rhodophyta (Red algae).

UNIT V Microbial Interaction (16 Period)

Symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism. Microorganisms in the rhizosphere, root surfaces and phylloplane - biofertilizers - biological nitrogen fixation- symbiotic and asymbiotic, mass production by rhizobium, azotobacter and cyanobacteria. Biological control of soil - borne microbial pathogens and nematodes - microbial pesticides. Interaction of synthetic pesticides with soil microorganisms. Quorum sensing and Quanching.

REFERENCES

1. Ingraham, J. L. and Ingraham, C. A. 2004. Introduction of Microbiology: A Case History Approach. 3rd Edition. Thomson Brooks/Cole, *Pacific Grove*.
2. Madigan, M.T. and Martinko, J.M. 2006. Brocks Biology of Microorganisms. 11th Edition. *Pearson Education Inc*.
3. Pelczar, M. J., Chan, E.C.S. and Krieg, N. R. 1993. Microbiology. 5th Edition. *Tata MacGraw Hill Press*.
4. Prescott, L.M., Harely, J.P. and klein, D.A. 2005. Microbiology. 6th Edition. *MacGraw Hill Companies Inc*.
5. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2013. Prescott's Microbiology. 8th Edition. *McGraw-Hill Higher Education*.
6. Salle, A. J. 1971. Fundamental Principles of Bacteriology. 7th Edition. *Tata MacGraw Hill Publishing Co.*

CORE COURSE : II
MICROBIAL METABOLISM

Semester : I	**Max Marks : 75**
Course Code : 18PMB1C2	**Credit : 4***
Total Period : 75	**Exam Hrs : 3**

Objectives

To make the students to understand the metabolism of microbes

UNIT I Ultra structure of Eubacteria and Archae Bacteria (15 Period)

Cell theory- types and structure of cell wall, plasma membrane, outer membrane, mitochondria, chloroplast, golgi complex, PHB, gas vesicles, ribosome, endoplasmic reticulam, nuclus. pili, fimbriae, microtubules and flagella-chemotaxis.

UNIT II Microbial Growth (19 Period)

Microbial nutrion - autotroph, phototroph, heterotroph, organotroph, lithotrophs and Winogradsky column. Nutrient transport mechanisms - uniport, symport and antiports - active, passive, facilitated diffusions and group translocation - siderophore in iron transport. Phases of growth - synchronous growth, diauxic growth and continuous growth. Factors influencing microbial growth- Cell division - mechanisms involved in formation of Z-ring. Sporulation and vegetative cell formation in *Bacillus* sp.

UNIT III Microbial Metabolism (11 Period)

Carbon assimilation- oxygenic and anoxygenic photosynthesis - Calvin cycle. Metabolism - catabolism- fermentation and respiration-EMP pathway-Pasture effect, ED pathway, Glyoxalate pathway, Krebs cycle. Anabolism- gluconeogenesis and reverse TCA cycle.

UNIT IV Microbial Pigments (17 Period)

Brief account of photosynthetic and accessory pigments. Fluorescences and phosphoroscenses in bacteria. Bacterio chlorophyll, rhodpsin, carotenoids, phycobiliproteins, Pulcherrimin, indigoidin, voalecin. Defensive role of pigments. Bioluminescence mechanism - advantages. Electron carries - artificial electron donors - inhibitors - uncouplers - energy bond - phosphorylation.

UNIT V Extremophiles Physiology (13 Period)

Effect of oxygen toxicity, pH, osmotic pressure, heat shock on bacteria adaptations in thermophiles, halophiles, alkaliphiles, acidophiles. Osmolarity porin regulation (Omp system) and Pho system in *E.coli*. Extremophiles- adaptations and significance in biotechnology.

REFERENCES

1. Murray, R.K. Granner, M. D., Mayes, P.A. and Rodwell, V.W. 1990. Biochemistry. *Prentice Hall International Inc.,* London.
2. Stryer, L. 1990. Biochemistry, 4th Edition. *Freeman, W.H. & company*, New York.
3. Madigan, M.T., Mrtinko, J. M. and Parker, J. 2000. Brock Biology of Microbiology. 9th Edition. *Prentice Hall International*, USA.
4. Moat, A .G., Foster, J.W. and Spector, M.P. 2009. Microbial Physiology. 4th Edition. *Wiley Publication*, India.
5. Pelczar, M.J.R., Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. 5th Edition. *McGraw Hill. Companies Inc*. New York.
7. Prescott, L.M., Harley, J.P. and AKlein, D. 2007. Microbiology. 7th Edition. *McGraw Hill*. *Companies Inc*. New York.
6. Caldwell, D.R. Microbial Physiology and Metabolism. 1995. WM. C. Brown Publishers, (USA Edition). *LPE-Pearson Education, Inc.*
7. John, Ingraham and Catherine, Ingraham. 2004. Introduction to Microbiology. 3rd Edition. *Thomson Brooks/cole publication*.
8. Gottychalk, G. Bacterial Metabolism. 2nd Edition. Springer - Verlag, Berlin. Hissar, Agricultural University, *Prentice Hall of India Pvt. Ltd.,* Delhi, 1986.
9. Doelle, H.W. Bacterial Metabolism 2nd Edition. Elsevier Publication, *Academic press*, New Delhi, India.2005.

CORE COURSE: III

MICROBIAL BIOCHEMISTRY

Semester : I	**Max Marks : 75**
Course Code : 18PMB1C3	**Credit : 4***
Total Period : 75	**Exam Hrs : 3**

Objective

To provide a solid foundation in the biochemical concepts which are needed for the practice of medicine.

UNIT I Carbohydrates and Proteins (15 Period)

Properties and classification- monosaccharides - isomerism and anomerism. Disaccharides and polysaccharides - structures of starch and glycogen. Protein - properties of aminoacids. Classification of proteins. Structure of protein - primary, secondary, tertiary and quaternary structure.

UNIT II Lipid and Nuclic acids (15 Period)

Biological importance and classification of lipids. properties and types of fats and fatty acid - β-oxidation. Biosynthesis of cholesterol. Nucleic acid - biosynthesis and degradation (de novo and salvage pathway)

UNIT III Vitamins (13 Period)

Discovery, role and chemistry of fat soluble vitamins A, D, E and K. Water soluble vitamins - Pantothenic acid, niacin, pyridoxine, biotin, riboflavin, cyanocobalamine, folic acid and ascorbic acid.

UNIT IV Enzymes (18 Period)

Enzyme - classification , specificity, active site and isozymes. Factors affecting enzyme efficiency, enzyme activators, coenzymes and cofactors. Enzyme kinetics - Michaelis - Menton equation, determination of kinetic parameters, multi-step reactions and enzyme inhibition. Allostersim - kinetic analysis and principles of allosteric regulation.

UNIT V Bio Signaling

(14 Period)

Molecular mechanism of signal transduction - gated ion channel, cell surface receptor and hormones. Signaling through G protein coupled receptor and second messengers. Protein kinase in signal transduction. Regulation of signaling pathways and programmed cell death.

REFERENCES

1. Deb, A. C. 2001. Fundamentals of Biochemistry. 7th Edition. *New central book agency (p)ltd.* India

2. Thomas M. Deblin. 1997. Textbook of Biochemistry With Clinical Correlations. 4th Edition. *A John Wiley and sons, Inc., publications*, New York.

3. Sathyanarayana, U. 2002. Biochemistry. 2nd Edition. *Arun Ba Sen books and allied pvt ltd*. Kolkata

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4. AmbikaShanmugam, 2003. Fundamental of Biochemistry for Medical Students. Revised Edition.

Published by the Author, 17. III Cross street, west CIT Nagar, Chennai-35

5. Chatterjea, M.N. and Shindea, R. 2007. A Text Book of Medical Biochemistry. *Jaypee Brothers Medical Publishers (P) Ltd*., New Delhi.

6. Murray, R.K., Grannes, D.K. and Rodwell, V.W. 2006. Harper's Illustrated Biochemistry. 27th Edition. *McGraw Hill Companies*, New York.

CORE COURSE : IV

Practical I: General Microbiology, Microbial Metabolism and Microbial Biochemistry

Semester : I	**Max Marks : 60**
Course Code : 18PMB1C4P	**Credit : 4***
Total Period : 75	**Exam Hrs : 3**

GENERAL MICROBIOLOGY

Objectives

To impart hands on training in general microbiology

1. Enumeration of Bacteria and Fungi - Viable plate count.
   (5 Period)
2. Pure culture techniques- Streak plate method
   (5 Period)
3. Measurement of size of microbes - micrometry method.
   (5 Period)
4. Motility determination - Hanging drop method and stab method
   (5 Period)
5. Staining methods- Gram staining, Acid fast, Endospore, PHB and Capsule staining.
   (5 Period)

MICROBIAL METABOLISM

Objectives

To learn the principles and methodology for isolation and biochemical characterization of microorganism

6. Measurement of growth curve - Direct and indirect methods.
   (10 Period)
7. Effect of pH and Temperature on microbial growth. **(5 Period)**
8. Biochemical tests: IMVIC, Catalase, Oxidase, TSI test, Gelatin, casein, starch Hydrolysis, and Urease test.
   (5 Period)
9. Antibiotic sensitivity test **(5 Period)**

MICROBIAL BIOCHEMISTRY

Objectives

To know the concepts pertaining to biomolecules estimation

10. Acid base Titration and PKa determination
    (5 Period)

11. Estimation of total Carbohytrate by Anthron method

(5 Period)

12. Estimation reducing sugar

(5 Period)

13. Separation of amino acid by Thin layer chromatography

(5 Period)

14. Total protein estimation – Lowery *et al* method

(5 Period)

REFERENCES

1. Aneja, K.R. 2003. Experiments in Microbiology, Plant pathology and Biochemistry. 4th Edition. *New age International publishers*, India.

2. Cappuccino and James, G. 1996. Microbiology a Laboratory Manual. 4th Edition. *Addison Wesley Publishing Company Inc.* England, California

3. Wilson, K. and Walker. Practical Biochemistry, Principles and Techniques. 1995. *Cambridge University Press*.

4. Jayaraman, J. 2011. Laboratory Manual in Biochemistry 2nd Edition. *New age International publishers*, India.

ELECTIVE COURSE: I

PHARMACEUTICAL MICROBIOLOGY

Semester : I	**Max Marks : 75**
Course Code : 18PMB1E1A	**Credit : 4***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To provide fundamental knowledge about pharmaceutical values of microbes

UNIT I Antibiotics and Synthetic Antimicrobial Agents (13 Periods)

Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines, ansamycins, macrolid antibiotics) antifungal antibiotics, antitumor substances. Peptide antibiotics, chloramphenicol, sulphonamides and quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives.

UNIT II Mechanism of Action of Antibiotics (16 Periods)

Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Molecular principles of drug targeting. Drug delivery system in gene therapy bacterial resistance to antibiotics. Mode of action of bacterial killing by quinolinones. Bacterial resistance to quionolinones. Mode of action of non - antibiotic antimicrobial agents. Penetrating defenses - How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

UNIT III Microbial Production (16 Periods)

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization. Manufacturing procedures and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines.Vaccine clinical trials.

UNIT IV Regulatory practices (15 Periods)

Biosensors and applications in pharmaceuticals financing R&D capital and market outlook. IP, BP, USP. Government regulatory practices and policies, FDA perspective. Reimbursement of drugs and biologicals, legislative perspective. Rational drug design. Immobilization procedures for pharmaceutical applications (liposomes). Macromolecular, cellular and synthetic drug carriers. Biosensors in pharmaceuticals.Application of microbial enzymes in pharmaceuticals.

UNIT V Quality Assurance and Validation (15 Periods)

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization)

Chemical and biological indicators.Design and layout of sterile product manufacturing unit. (Designing of Microbiology laboratory) Safety in microbiology laboratory.

REFERENCES

1. By, W.B. and Hugo, A.D. 2010. Pharmaceutical Microbiology. 6th Edition. *Blackwell scientific Publications*.
2. Frederick Kavanagh. 1972. Analytical Microbiology. Vol. I & II. *Academic Press*, New York.
3. David, C., Hooper John S. and Wolfson, A.S.M. 1989. Quinolinone antimicrobial agents. Washington, D.C: *American Society for Microbiology.*
4. Murray, S. Cooper.1972. Quality control in the Pharmaceutical Industry. Vol. 2. *Academic Press*, New York.
5. Rehm, H. and Reed, J. Biotechnology. Vol. 4. *VCH Publications*, Federal Republic of Germany.
6. Vyas, S.P. and Dixit, V.K. Pharmaceutical Biotechnology. 2007. *CBS Publishers & Distributors*, New Delhi.
7. Sydney, H. Willig, Murray, M. Tuckerman and William S. Hitchings. 2004. Good Manufacturing Practices for Pharmaceuticals. 2nd Edition. *Mercel Dekker NC*, New York.
8. Paine Webber. 1994. Advances in Applied Biotechnology Series Vol. 10 – Biopharmaceuticals in transition. Industrial Biotechnology Association, *Gulf Publishing Company*, Houston.
9. Gregory Gregoriadis. 1979. Drug Carriers in biology and Medicine. *Academic Press*, New York.
10. Rajesh Bhatia. 1994. Vaccine and Immobilization against Infectious Disease. *Jaypee Brothers Medical Publishers (P) Ltd*. New Delhi

ELECTIVE COURSE : I

IPR AND BIOETHICS

Semester : I	**Max Marks : 75**
Course Code : 18PMB1E1B	**Credit : 4***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To impart knowledge about Property rights and laws of biotechnological inventions

UNIT I Biosafety (10 Periods)

Introduction - biosafety issues in biotechnology - historical background. Biological safety cabinets, Primary containment for biohazards. Biosafety levels - levels of specific microorganisms, infectious agents and infected animals.

UNIT II Biosafety Guidelines (15 Periods)

Guidelines and regulations (National and International including Cartegana Protocol) - operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. Environmental release of GMOs - Risk - analysis, assessment, management and communication.

UNIT III Intellectual Property Rights (18 Periods)

Introduction to IPR, types of IP - patents, trademarks, copyright & related rights, industrial design, traditional knowledge and geographical indications. Importance of IPR – patentable and non patentables, patenting life, legal protection of biotechnological inventions. Agreements and treaties - history of GATT & TRIPS agreement, madrid agreement, Hague agreement, WIPO

treaties; budapest treaty; PCT, Indian patent Act 1970 & recent amendments. IPR and WTO regime - consumer protection and plant genetic resources.

UNIT IV Patents and Patent Laws (17 Periods)

Objectives of the patent system - basic, principles and general requirements of patent law. Biotechnological inventions and patent law - Legal development - Patentable subjects and protection in Biotechnology. Patent filing procedures - National & PCT filing procedure, time frame and cost, Status of the patent applications, precautions while patenting, disclosure/ nondisclosure, financial assistance for patenting, introduction to existing schemes. Patent licensing and agreement. Patent infringement - meaning, scope, litigation, case studies.

UNIT V Bioethics (15 Periods)

Introduction to ethics and bioethics, framework for ethical decision making. ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Ethical implications of GM crops, GMO's, human genome project, human cloning, designer babies, biopiracy and biowarfare. Eugenics and its possible approaches. Animal right activities - Blue cross in India- society for prevention of cruelty against animals. Ethical limits of animal use. green peace - human rights and responsibilities.

REFERENCES

1. Beier, F.K., Crespi, R.S and Straus, T. 1986. Biotechnology and Patent protection, *Oxford and IBH Publishing Co*. New Delhi.
2. Jeffrey M. Gimble, 2005. Academia to Biotechnology, *Elsevier Academic Press*.
3. Rajmohan Joshi. 2006. Biosafety and Bioethics. *Isha Books*, New Delhi.
4. Sasson, A, 1988. Biotechnologies and Development, *UNESCO Publications.*
5. Senthil Kumar, S. and Mohammed Jaabir M. S. 2008. IPR, Biosafety and Biotechnology Management, *Jasen Publications*, India

APPLICATION ORIENTED COURSE

BIOINSTRUMENTATION

Semester : I	**Max Marks : 60**
Course Code : 18PMB1A1	**Credit : 3***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To impart the knowledge about instruments

UNIT I Microsopy (13 Periods)

Microscopy - principles and applications. Types - dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy - TEM and SEM.

Unit II Chromatography and Centrifuge Technique (15 Periods)

Chromatographic techniques: General principles of chromatography. Principles, operational procedure and applications of paper, thin layer, ion exchange, molecular sieving, affinity and gas-liquid chromatography. High performance liquid chromatography (HPLC). Centrifuge – principles, types and uses.

UNIT III Electrophoresis and Filtration Techniques (19 Periods)

Principles, procedure, types and application of electrophoresis. Types – Polyacrylamide gel electrophoresis, SDS-PAGE, 2DElectrophoresis, isoelectric focusing. Agarose gel electrophoresis, staining, fluorescence, pulsed field electrophoresis, high voltage electrophoresis, capillary electrophoresis. Filtration - Theory of filtration, Batch and continuous filters, filter media. Classification of filters - filter press, leaf filters, filter candles, sintered filters, membrane filters.

UNIT IV Instrumental Operation Based on Electromagnetic Radiation (10 Periods)

Spectrophotometry principle, instrumentation and application. Flamephotometry: atomic absorbance and emission spectra. Beer-lamberts Law, absorption and its transmittance.

UNIT V Radio Isotope Techniques (18 Periods)

Atomic structure, radiation, type of radio active decay, half- life and units of radioactivity. Detection and measurement of radioactivity- methods based upon ionization GM counter, excitation (scintillation counter). Auto radiography and isotope dilution techniques. radio immuno assay.

REFERENCES

1. Keith Wilson and John Walker. 1994. Principle and Techniques of Practical Biochemistry. 1994. *Cambridge Press*.

2. Shawney and Randhirsingh, 2001. Introduction to Practical Biochemistry. *Narasa publications*, New Delhi.

3. Turner, R.B. 1977. Analytical biochemistry. *Elsevier*, New York.

4. Arumugam, M. 2002. Biomedical instrumentation. *Anuradha agengies*, Chennai.

5. Bryan, L. 1992. Principles and Techniques of Practical Biochemistry. Williams and Keith Wilson, *Cambridge University Press*.

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CORE COURSE : V
ADVANCED VIROLOGY

Semester : II	**Max Marks : 75**
Course Code : 18PMB2C5	**Credit : 5***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To study general aspect of viral structure and its significance on immunity.

UNIT I General Virology (15 Periods)

Brief outline on discovery of viruses (origin and evoluation), terminology. Nomenclature and classification of viruses. Morphology and structure of viruses. Chemical composition of viruses. Assay of viruses.

UNIT II Bacterial viruses (17 Periods)

Bacteriophages - structural organization; life cycle (extra cellular phase;attachment, penetration of nucleic acid, transcription, translation, replication, maturation and release of phage particles) of ϕX174,T4, lambda, M13 and MU Phages. Bacteriophage - typing, one step growth curve.

UNIT III Plant viruses (11 Periods)

Lifecycle, pathogenesis and laboratory diagnosis of following plant viruses-TMV, Cauliflower mosaic virus, potato virus, NPV, Tomato spot virus, Maize, sugarcane viruses.

UNIT IV Animal Viruses (15 Periods)

Lifecycle, pathogenesis and laboratory diagnosis of following animal viruses – RNA viruses - picorna, orthomyxo, rhabdovirus and HIV. DNA viruses - pox, herpes, adeno and hepatic viruses, oncogenic viruses - papova viruses, EB Virus, HTLV virus.

UNIT V General Methods of Diagnosis, Antiviral Drugs and Agen (17 Periods)

Serological methods - haemagglutination, complement fixation, immunofluorescence, ELISA and radioimmunoassay (RIA). Antiviral drugs and agents - types of IFN, structure and mechanism of amantadine, rimantadine, viderabine, acyclovir, ganciclovir, ribavirin, NNRTIS (Non - Nuleoside RT inhibitors) - nevirapine, delavirdine and efavirenz. Protease inhibitors - saquinavir, indinavir and ritonavir.

REFERENCES

1. Dimmock, N.J. and Primrose, S.B.1994. Introduction to Modern Virology. 4th Edition. *Science Ltd*.

2. Dimmock, N.J., Eatson, A.L, Leppard, K.N. 2007. Introduction to Modern Virology.6th Edition. *Blackwell Publishing Ltd*.

3. Carter, J. and Saunders, V. 2007. Virology: Principles and Applications. *John wiley and Sons publications.,*

4. Alan, J. Cann. 1997. Principles of Molecular virology. 2nd Edition. *Academic press*.

5. Conrat, H.F, Kimball, P.C. and Levy, J.A. 1988. Virology. 2nd Edition. *Prentice Hall*, Englewood Cliff.

6. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, V.R. and Skalka, A.M. 2000. Principles of Virology, Volume 2, Pathogenesis and Contorl. 3rd Edition. *Bookholders*.

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8. Saravanan, 2006.Virology. J.C Pillai, *MJP publishers*.

CORE COURSE : VI
MICROBIAL GENETICS

Semester : II	**Max Marks : 75**
Course Code : 18PMB2C6	**Credit : 4***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To provide the knowledge in fundamental principles and concept of prokaryotic genes and genomes, their molecular organization, replication and function.

UNIT I Prokaryotic and Eukaryotic Genome (15 Periods)

DNA structure, DNA types and replication- general principles, various modes of replication, Proof-reading, Inhibitors of DNA replication, the law of DNA constancy and C value paradox and topological manipulations. RNA as genetic material, Genetic code. Organization and functioning of prokaryotic bacterial genetic material. Details of *E.coli* chromosome.

UNIT II Bacterial Plasmids (15 Periods)

Structure and properties, replication, incompatibility, plasmid amplification. Bacteriophages - lytic development cycle - T4 - lytic and lysogenic development of phage, structure of bacterial transposons, types of bacterial transposons. Mechanism of antibiotic resistance and spread of antibiotic resistance.

UNIT III Regulation of Gene Expression in Prokaryotes (15 Periods)

Operon concept, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, inducers and repressors, Lac Operon system. Regulation by attenuation by trp operon. Gene expression - transcription - maturation and processing of RNA - Methylation, capping, polyadenylation and splicing of mRNA, Translation.

UNIT IV Gene Transfer Mechanism (15 Periods)

Genetic exchange in bacteria - transformation and transduction and conjugation- co-transduction and its use in genetic mapping-chromosome transfer by Hfr strains. Central dogma of molecular biology- Genetic code, Wobble hypothesis, Protein synthesis- the stages of protein synthesis- the process of translation in prokaryotes, factors involved in translation- the triplet nature of genetic code- an over view of comparisons with eukaryotic translation.

UNIT V Mutations (15 Periods)

Spontaneous and induced, basis pair changes, frame shifts, deletions, inversions, tandem duplications, insertions, useful phenotypes (auxotyphic, conditional lethal, resistant), reversion vs. suppression, Ames test - fluctuation test and its significance - complementation. Mutagens- chemical and physical mutagens - UV, NTG and hydroxylamine- mode of action- isolation of auxotroph and drug resistance mutants- DNA damage and repair.

REFERENCES

1. Snyder, L. and Wendy, W. Molecular Genetics of Bacteria, 2/e, ASM press, Washington David Freifelder .S, 1987. Microbial Genetics, *Jones & Bartlett,* Boston.
2. Watson, J.D., Hoppkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. 1987. Molecular Biology of the Gene. 4th Edition. *The Benjamin / Cummings Publications Co. Inc.* California.
3. Robert, H. Tamarin and William, C. Brown. 1995. Principles of Genetics, 5th Edition, *WMC Brown Publishers*. Unites States.
4. Lewin, B. 1990. Genes, 6th Edition, *Oxford University Press*, England.
5. Gardner, E. J., Simmons, M .J and Snustard, D. P. 1991. Principles of Genetics, 8th Edition. *John Wiley &Sons*. New York.

6. Philip and Gerhardt. 1993. Methods of General and Molecular Bacteriology. *ASM Publications*.
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8. Dale, J. W. 1994. Molecular Genetics of Bacteria. *John Wiley and Sons*.
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13. James, D. Watson, Tania, A. Baker, Stephen, P. Bell, Alexander Gann, Michael Levin and Richard Losick. 2004. Molecular Biology of the Gene, 5th Edition. Pearson, *Benjamin Cummings and CSHL press.*
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CORE COURSE : VII
ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Semester : II	**Max Marks : 75**
Course Code : 18PMB2C7	**Credit : 5***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To understand the vital role and application of microorganisms on soil and agricultural field

UNIT I Soil Microbiology (15 Periods)

Soil - structure, types, physical and chemical properties. Weathering and humus formation, soil pollution. Soil microbes - Microbial flora of soil and factors affecting them. Types of microbial interaction. Outline biogeochemical cycles - carbon, nitrogen, oxygen, hydrogen, phosphorous, sulfur and iron.

UNIT II Aquatic Microbiology (14 Periods)

Water pollution and water borne pathogens, bacteriological examination of water, indicator organisms. Purification and disinfection of water, waste water treatment, BOD, COD. Role of microbes in marine fouling. Air droplet nuclei and air sampling techniques.

UNIT III Recycling of Liquid and Solid Wastes (12 Periods)

Composting, biogas, biodegradation, bioremediation, bioleaching, xenobiotic degradation. Microbial corrosion - biofilms degradation of petroleum products . Microbes in mineral leaching and metal concentration, microbial enhanced oil recovery.

UNIT IV Agro Ecosystem (14 Periods)

Definition, structure and functioning of agro ecosystems. Microbes in soil formation, role of microorganism in soil fertility, role of microbes in crop production, harmful role of microbes in agro ecosystem. Energy flow in agro ecosystems. System approach, constraints and strategies of IPM implementation. Important role of trees and soil. Characteristics and fertility, microclimate, hydrology associated biological components and productivity.

UNIT V Bioinoculants (20 Periods)

Biological fixation of nitrogen, Nitrogen fixation sites, symbiotic associate and nonsymbiotic nitrogen fixation. Mechanism of biological nitrogen fixation. Nitrogenase enzyme complex - azoferredoxin and molybdo ferrodoxin. mechanism of nitrogen reduction. Nif genes and its regulation. Role of hydrogenase enzyme in nitrogen fixation. Plant growth promoting Microbes (PGPM). Phosphate solublizing bacteria. Biological nitrogen fixers - Production and application of Rhizobium, Azospirillum, Phosphate and potassium solubilizing and utilizing bacteria - Blue green algae, Frankia and Mycorrhizae. Bt-toxin - mode of action and applications, Integrated pest management GM crops and its importance.

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3. Rheinherimer, G. 1991. Aquatic Microbiology. 4th Edition. *John Wiley and Sons publications*

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CORE COURSE : VIII

PRACTICAL -II ADVANCED VIROLOGY, MICROBIAL GENETICS, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Semester : II **Max Marks : 60**
Course Code : 18PMB2C8P **Credit : 3***
Total Periods : 75 **Exam Hrs : 3**

Objectives

To provide solid foundation on Virology

ADVANCED VIROLOGY

1. Isolation of bacteriophage from sewage **(5 Periods)**
2. Isolation of lambda DNA and their characterization **(5 Periods)**
3. Cultivation and assay of viruses using embryonated **(5 Periods)**

MICROBIAL GENETICS

Objectives

To impart hands training on microbial genetics

4. Isolation of Genomic DNA (crude method) **(5 Periods)**
5. Isolation of Auxotrophic mutant by replica plate method **(5 Periods)**
6. Isolation of drug resistant mutants by gradient plate method **(5 Periods)**
7. Isolation of plasmid DNA by alkaline lysis method (Demonstration only) **(5 Periods)**
8. Restriction digestion and agarose gel electrophoresis of DNA **(5 Periods)**

ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

Objectives

To acquired the knowledge about the techniques of agricultural microbiology

9. Isolation of nitrogen fixing bacteria from root nodules of legumes **(5 Periods)**
10. Localization of VAM fungi **(5 Periods)**
11. Algae as indicator of water pollution **(5 Periods)**
12. Screening of cellulase producing bacteria from soil **(5 Periods)**
13. Determination of indices of pollution by measuring BOD **(5 Periods)**
14. Determination of COD different effluents. **(5 Periods)**
15. Determination of phosphate solubulizing bacteria **(5 Periods)**

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1. Morag, C. and Tim bury, M.C .1994. Medical Virology. 10th Edition. *Churchil Livingstone*, London.

2. Dimmock, N.J., Primrose, S.B. 1994. Introduction to Modern Virology 4th Edition. *Blackwell Scientific Publication.* Oxford.

3. Topley and Wilsons 1995. Text Book of Principles of Bacteriology, Virology and Immunity. *Hodder Arnold*.

4. Maloy *et al*., 1994. Microbial Genetics. *Jones and Bartlett Publishers*.

5. Dale, J.W. 1994. Molecular Genetics of Bacteria. *John Wiley and Sons*

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ELECTIVE COURSE : II
MARINE MICROBIOLOGY

Semester : II	**Max Marks : 75**
Course Code : 18PMB2E2A	**Credit : 4***
Total Periods : 75	**Exam Hrs : 3**

Objectives

This subject aims to introduce the students to understand microbial diversity, significance, dynamics of marine environment, marine food borne pathogens, and marine microbial products.

UNIT I Introduction to Marine Microbes (18 Periods)

Marine microbial habitats and diversity - marine environment - properties of seawater, chemical and physical factors of marine environment - Ecology of coastal, shallow and deep sea microorganism - significance of marine microflora. Diversity of microorganism - archaea, bacteria, actinobacteria, cyanobacteria, algae, fungi, viruses and protozoa in the mangroves and coral environments - microbial endosymbionts - epiphytes - coral-microbial association, sponge-microbial association.

UNIT II Cultivation of Marine Microbes and Nutrient Cycling (14 Periods)

Methods of studying marine microorganisms - sample collection - isolation and identification. Cultural, morphological, physiological, biochemical and molecular characteristics - preservation methods of marine microbes. Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments and mangroves.

UNIT III Marine Extremophiles and Bioremediation (15 Periods)

Survival at extreme environments - starvation - adaptive mechanisms in thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms - hyperthermophiles, halophiles and their importance. Microbial consortia and genetically engineered microbes in bioremediation of polluted marine sites - heavy metals and crude oil. Biofouling and their control.

UNIT IV Seafood Microbiology (14 Periods)

Resource of seafood and preservation methods. Pathogenic microorganisms, distribution, indicator organisms, prevention and control of water pollution, quality standards, international and national standards. Microbiology of processed finfish and shellfish products. Rapid diagnosis of contamination in seafoods and aquaculture products.

UNIT V Marine Microbial Products (14 Periods)

Marine microbial products - carrageenan, agar-agar, sea weed fertilizers - astaxanthin, β carotene - enzyme -antibiotics - antitumour agents – polysaccharide - biosurfactants and pigments. Preservation methods of sea foods. Quality control and regulations for microbial quality of fishes, shellfish, marine drugs and Marine living resources used for food and drugs.

REFERENCES

1. Belkin, S. and Colwell, R.R. 2005. Ocean and health: Pathogens in the Marine Environment, *Springer*.
2. Bhakuni, D.S and Rawat, D.S. 2005. Bioactive marine natural products. *Anamaya Publishers,* New Delhi.
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ELECTIVE COURSE : II
INTRODUCTORY NANOTECHNOLOGY

Semester : II	**Max Marks : 75**
Course Code : 18PMB2E2B	**Credit : 4***
Total Periods: 75	**Exam Hrs : 3**

Objectives

To acquire the knowledge about role of microorganisms in nanoparticle biosynthesis

UNIT I Basic concepts in Nanotechnology (15 Periods)

Nanotechnology - Classification of nanostructures, nanoparticles, nano-clusters, nanotubes, nanowires and nanodots, liposomes, cubosomes and hexosomes, lipid based nanoparticles-liquid nanodispersions- solid lipid nanoparticles (SLP), effects of the nanometre length scale - nanoscale dimensions affect properties.

UNIT II Synthesis of Nanoparticles (15 Periods)

Chemical - pyrolysis - inert gas condensation, biological methods of nanoparticle synthesis - silver, zinc oxide, gold and titanium; intracellular synthesis and extracellular synthesis, mechanism of synthesis of nanoparticles, properties; assembly. Inorganic, organic and hybrid nanomaterials.

UNIT III Characterization Techniques (15 Periods)

Structural studies of Nanoparticles - XRD and FT- IR. Microscopic techniques- electron Microscopy- SEM, TEM, biological sample preparation for TEM- scanning probe microscopy- STEM- AFM- confocal Microscopy- Scanning Near Field Microscopy- Spectroscopic and Electrochemical techniques- UV-Vis Spectroscopy- Energy Dispersive X-ray spectroscopy, Mass spectroscopy-types- Nuclear Magnetic Resonance (NMR) spectroscopy.

UNIT IV Biomedical Applications (13 Periods)

Antimicrobial activity of nanoparticles- antibacterial, antifungal, antiviral, antiparasitic, antihelmenthic, mosquito larvicidal, bacterial sporicidal, insecticidal activity, herbicidal activity. mechanism; mode of action of nanoparticles on microbial growth- changes in membrane permeability, oxygen consumption measurement, protein leakage analysis.

UNIT V Biocomputational Approach (17 Periods)

Assembly and characterization of biomolecule–gold nanoparticle conjugates and their use in intracellular imaging - whole-blood immunoassay facilitated by gold nanoshell–conjugate antibodies - assays for selection of single-chain fragment variable recombinant antibodies to metal nanoclusters - surface-functionalized. Nanoparticles for controlled drug delivery - structural DNA nanotechnology - nanostructured DNA templates - probing DNA structure with nanoparticles.

REFERENCES

1. Banerjee, P., Satapathy, M., Mukhopahayay, A. and Das, P. 2014. Leaf extract mediated green synthesis of silver nanoparticles from widely available Indian plants: synthesis, characterization, antimicrobial property and toxicity analysis. *Bioresources and Bioprocessing*, 1(1), 3.

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6. https://www.coursera.org/learn/stem/lecture/9ZN3W/nanotechnology-around-the-world

7. https://www.coursera.org/learn/nanotechnology/lecture/apP2j/welcome-to-the-course

8. https://fr.coursera.org/learn/stem/lecture/iSFJP/the-burning-of-fossil-fuels

APPLICATION ORIENTED COURSE

MUSHROOM TECHNOLOGY

Semester : II	**Max Marks : 75**
Course Code : 18PMB2A2	**Credit : 3***
Total Periods : 75	**Exam Hrs : 3**

Objectives

To provide knowledge on application of mushroom

UNIT I Scope and Development of Mushroom (15 Periods)

Classification of edible mushrooms - medicinal value of mushrooms - Edible mushroom cultivation -Types of edible mushroom available in India - *Calacybe indica, Volvariella Volvacea, Pleurotus sp., Agaricus bisporus.*

UNIT II Food Value and Composition of Mushroom (15 Periods)

Protein, vitamins, minerals, carbohydrates, fibre, fat - Pure culture- preparation of media (PDA and Oatmeal agar media) sterilization - Preparation of test tube slants to store mother culture - culturing of *Pleuretus* mycelium on petriplates - Preparation of mother spawn in bottles and polypropylene bags and their multiplication.

UNIT III Cultivation Technology (15 Periods)

Infra structure, substrates (locally available) polythene bag, vessels, inoculation hood - low cost stove -sieves - Cultural rack mushroom unit (Thatched house) - Mushroom bed preparation - Paddy straw, sugarcane trash, maize straw, banana leaves- post harvest technique - packing- transport- storage- short term storage - long term storage-Cultivation of button mushroom.

UNIT IV Pests and Diseases of Edible Mushrooms (15 Periods)

Fungal diseases - dry bubble, wet bubble, cob web disease, green moulds, competitor moulds - bacterial diseases - bacterial blotch - viral diseases – insect - sciarid flies, phorid flies, cecid files - mushroom mites – beetles - Nematodes.

UNIT V Economics of Mushroom Cultivation (15 Periods)

Fixed assets, recurring expenditure, labour, economics of cultivation throughout the year and seasonal growing formulation of project report for getting finance from funding agencies. Precautions in mushroom cultivation. Mushroom recipes- western and indian recipes, pickles, powders, jams. Medicinal properties of mushroom.

REFERENCES

1. Baumberg, S., Hunter, I.S. and Rhodes, P.M. 1989. Microbial Products –New approaches. *Cambridge University Press*, Cambridge.

2. Demain, A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology and Biotechnology. *ASM press.*

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CORE COURSE : IX

IMMUNOLOGY AND MEDICAL MICROBIOLOGY

Semester: III **Max Marks : 75**

Course Code: 18PMB3C9 **Credit : 5***

Total Period: 75 **Exam Hrs : 3**

Objectives:

To impart the knowledge about the immune system, its type, its concepts and to know the medically important human diseases with respect to its causative agent and clinical syndromes.

UNIT I-Immunity **(15 Periods)**

Definition, types (natural, acquired, active and passive), Mechanism of innate immunity. Antigens: Definition, Types of antigens, factors influencing antigenecity. Immunoglobulin: Definition, structure, types, properties, and functions of immunoglobulin. Antigen and antibody reactions: precipitation, agglutinations, complement fixations, ELISA.

UNIT II -Hypersensitivity (15 Periods)

Types (I, II, III, IV), Mediators of hypersensitivity reactions, mechanism of mast cell degranulation and detection of type hypersensitivity. Transplantation immunology: Types, graft acceptance, genetic basis of graft rejection, mechanism and manifestations of graft rejection.

UNIT III - Immunotolerence (15 Periods)

Natural immunological tolerance - APL concept , Adaptation concept ,Anergy concept Oral tolerance – Pathway , High and low dose , Food allergy Maternal immune tolerance – Hypothesis, Auto immune disorders.

UNIT IV -Medical Microbiology (15 Periods)

Definition, primary, Nosocomial, inapparent, atypical, sources of infection, transmission methods of infection. Factors or mechanisms of microbial pathogenesis. Epidemiology ,pathogenesis & prophylaxis following disases – bacterial diseases (Tuberculosis, Cholera, Typhoid Diseases), Fungal diseases (Cutaneous mycoses, systematic mycoses, opportunistic mycoses), Viral diseases (Dengue, Ebola , Nipha virus) and Protozoan diseases – Amoebiasis, Giardiasis, Malaria, Trypanaosomiasis).

UNIT V – Specimen collection - Regulations (15 Periods)

Precautions , procedure for collection of Urine ,Blood ,CSF Throat swab, Sputum , Stool samples and processing . Decontamination of specimen.

REFERENCES

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CORE COURSE: X

MICROBIAL FOOD TECHNOLOGY

Semester : III **Max Marks : 75**

Course Code : 18PMB3C10 **Credit : 4***

Total Periods : 75 **Exam Hrs : 3**

Objectives:

The subject aims to study about the food microflora, food fermentation, food preservation, food spoilage and food quality control

UNIT I-Food Microbiology (15 Periods)

Food as a substrate for microorganism, micro-organism important in food microbiology- molds, yeasts and bacteria; Brief account of each group; General characteristics and importance. Factors affecting growth - pH, moisture, temperature, water activity, oxygen.

UNIT II-Food spoilage and contamination (15 Periods)

General principles underlying food spoilage and contamination; vegetables, fruits, egg, meat, fish. Microbial role in production of bread, vinegar, sauerkraut, beer and wine. Cultivation of mushroom.

UNIT III-Fermented Foods & Preservation (15 Periods)

Fermented foods - Beer , Bread, Cheese, Sauerkraut, Wine , Vinegar , Yogurt and its preservation techniques.

UNIT IV-Examination of milk and milk product (15 Periods)

Bacteriological examination of milk. Preservation of milk, pasteurization –different methods and advantages, sterilization, dehydration, bacteriological standards and grading of milk. fermented dairy products- cheese, cultured buttermilk, ice cream, condensed and dry milk products, yoghurt, low lactose milk, Milk protein

UNIT V -Food borne diseases & Sanitation (15 Periods)

Food poisonings and food born infections and intoxication. Mycotoxins in food with reference to *Aspergillus*. Microbiology of food sanitation –Hazard Analysis Critical Control Points (HACCP), Microbiological criteria for food.

REFERENCES

1. Casida, L.E.1968.Industrial Microbiology.Wiley,New York, London.
2. Doyle, M.P., Beuchat, L.R and Montville,T.J. 2001.Food Microbiology: Fundamentals and frontiers.2nd Edition, ASm press, Washington,D.C.
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CORE COURSE: XI

RECOMBINANT DNA TECHNOLOGY

Semester : III **Max Marks : 75**
Course Code : 18PMB3C11 **Credit : 5***
Total Period : 75 **Exam Hrs : 3**

Objectives:

To understand the role of enzymes, properties of vectors, methodologies and applications of Recombinant DNA technology and to discuss different types of PCR, its principle, applications and its sequencing methods.

UNIT - I Enzymes and Techniques in genetic recombination (15 Period)

Outline to recombinant DNA technology, enzymes used in recombination: restriction endonucleases (type I, II, III), properties, nomenclature. DNA ligase: Properties and specificity, alkaline phosphatase, polynucleotide kinase, DNA polymerase, reverse transcriptase and its mode of action. Cohesive and blunt end ligation, linkers, adaptors and homopolymeric tailing. Labeling of DNA – nick translation, random priming, radioactive and non-radioactive probes.

UNIT - II Plasmids (15 Period)

Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, PBR322 – its construction and derivatives, Bacteriophage lambda (λ) as a vector: essential features, organization of λ genome, λ EMBL vectors. Phagemids, insertion and replacement vectors, cosmids , Expression vectors – pMal and pET based vectors.

UNIT - III Cloning Methodologies (15 Period)

Insertion of foreign DNA into host cells, isolation of mRNA and total RNA, cDNA and genomic libraries , cDNA and genomic cloning, short gun cloning, directed cloning, phage display. Expression cloning and protein - protein interactive cloning. Yeast two hybrid system.

UNIT - IV PCR and its Applications (15 Period)

Primer design, fidelity of thermostable enzymes, Types of PCR - multiplex, nested, reverse transcriptase, real time, touchdown, hot start and colony. Single-strand conformation polymorphism (SSCP), Denaturing gradient gel electrophoresis (DGGE), RAPD, RFLP, oligo ligation assay (OLA).

UNIT - V Sequencing Methods (15 Period)

DNA sequencing (Enzymatic, chemical & automated sequencing), Chemical synthesis of oligonucleotides, Gene silencing techniques - introduction to siRNA, siRNA technology, micro RNA, principle and application of gene silencing , cDNA and intragenic arrays, differential gene expression and protein array# and Next generation sequencing (NGS).

REFERENCES

1. Watson, J.D., M.Gillman, J.Witknow Ski and M.Zoller. Recombinant DNA (2nd Ed), Scientific Americans books, New York. 1992.
2. Innis, M.A., D.H. Gelfant&J.J.Sninskey.. PCR Strategies,. IRL Press. 1995.
3. Watson, JD. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner. Molecular Biology of the Gene. 6th Edition. Benjamin Cummings Publishing Company Inc. 2007.

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CORE COURSE: XII

Practical-III Immunology and Medical Microbiology, Microbial Food Technology and Recombinant DNA Technology

Semester : III **Max Marks : 60**

Course Code : 18PMB3C12P **Credit : 5***

Total Period : 75 **Exam Hrs : 6**

IMMUNOLOGY AND MEDICAL MICROBIOLOGY (P)

Objectives:

Obtain a significant knowledge on fundamental and advanced aspects of Immunology and Medical Microbiology

1. Blood test – TC, DC and Total count RBC,WBC **(6 Periods)**
2. Agglutination of WIDAL Test **(4 Periods)**
3. precipitation – ouchterlony double diffusion test **(4 Periods)**
4. Demonstration of Qualitative analysis ELISA **(4 Periods)**

5. Isolation of pathogens from urine sample and pus sample **(8 Periods)**
6. Antibiotic sensitivity testing –E test method. **(4 Periods)**
7. KOH and GERM test **(3 Periods)**

MICROBIAL FOOD TECHNOLOGY (P)

Objectives:

Understand the importance of safe handling of food and the role of microorganisms in environment, Industry and in maintenance of health.

8. Wet Mount Preparation of Spoiled bread, tomato, grapes and potato **(3 Periods)**
9. Assessment of milk quality by methylene blue reduction test **(5 Periods)**
10. Coagulation test for Milk **(4 Periods)**

RECOMBINANT DNA TECHNOLOGY (P)

Objectives:

To improve knowledge and enhance skills to the state- of- Gene technology

11. Preparation competent cell **(6 Periods)**
12. Demonstration of transformation **(6Periods)**
13. Demonstration of PCR **(6 Periods)**
14. Demonstration of RAPD **(6 Periods)**
15. Demonstration of Blotting techniques **(6 Periods)**

REFERENCES

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2. Tarwar , G.P . and gupta , S.K .(1992). A. Hand book of practical and clinical immunology. CBS Publications, new delhi.
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5. Ananthanarayana paniker, Text book of microbiology orient and longman , new delhi.

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ELECTIVE COURSE: III

FERMENTATION TECHNOLOGY

Semester : III	**Max Marks : 75**
Course Code : 18PMB3E3A	**Credit : 4***
Total Periods : 75	**Exam Hrs : 3**

Objectives:

To empower the students with various designs of fermenter . The Knowledge on fermentation process enables the students to manipulate microbes for improvement.

UNIT I-Introduction (15 Periods)

Industrially important microorganism – screening techniques – primary and secondary - preservation of cultures – strain improvement – development of inoculums for various fermentation process.

UNIT II-Media & Sterilization (15 Periods)

Media for industrial fermentation – Crude and synthetic media , components of fermentation – Carbon ,Nitrogen, vitamins and minerals sources , role of buffers, Precursors , inhibitors , Inducers and antifoams. Types of fermentation – solid state and liquid state (stationary & submerged) . Sterilization of fermentation equipment ,air and media

UNIT III-Fermentor (15 Periods)

Fermentor- components of fermentor – types of bioreactors – control and monitoring of different parameters in abioreactor (pH, temperature, dissolved oxygen, foaming and aeration) computer applications in fermentation technology.

UNIT IV- Fermented products (15 Periods)

Microbial production of wine, ethanol, organic acid – citric acid and lactic acid, amino acid – lysine, enzyme – α-amylase, vitamin B12 , Pre and Probiotic .

UNIT V- Downstream Processing (15 Periods)

Recovery and purification of fermentation products (intracellular and extracellular), cell disruption , precipitation , filtration , centrifugation , solvent recovery , chromatography , ultra filtration and drying , quality assurance of finished products . immobilization of cell and enzymes .

REFERENCES

1.Prescott, S. C., Dunn, C.G. and Reed, G. 1982. Proscott and Dunn's Industrial Microbiology, 4th Edition. AVI pub. Co., Westport, Conn.

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ELECTIVE COURSE - III

GENE TECHNOLOGY

Semester: III **Max Marks : 75**

Course Code: 18PMB3E3B **Credit : 4***

Total Periods: 75 **Exam Hrs : 3**

Objectives:

To educate the students with the advanced tools, technique and methods employed in DNA/ gene cloning and expression as well as in protein Engineering.

UNIT I -Molecular tools for gene cloning (15 Periods)

Exonucleases and endonucleases, restriction enzymes (Type I, Type II, Type III, Type IV and Type V), Rnases, Methylases. Polymerases: DNA Pol I, Klenow fragments, reverse transcriptase, Taq polymerases. Ligases: T4 DNA ligase, *E. coli* DNA ligase, T4 RNA ligase. Topoisomerase: Type I & Type II. End modifying enzymes: Terminal transferase, T4 polynucleiodite kinase, alkaline phosphatases.

UNIT II -Vectors and Gene Cloning (15 Periods)

Introduction to cloning vectors – Desirable properties of vectors- prokaryotic and eukaryotic expression systems (constitutive & inducible). Plasmid vectors – Phage vectors - cosmids – Phagemids – BACs yeast vectors – YACs – lentiviral vectors- adenoiral vectors- plant vectors.

UNIT III-Advanced techniques in molecular biology (17 Periods)

Polymerase Chain Reaction - Quantitative Real Time PCR-Gel Electrophorosis: AGE & PAGE - Blotting techniques: Southern, Western & Northern. Methods of gene transfer in plant and animals: chemical, physical & viral mediated DNA transfer. Construction of genomic & cDNA libraries- DNA sequencing – Protein engineering: Site directed mutagenesis- reporter gene assay- DNA protein interactions: EMSA, DNA footprinting – protein protein interaction:Y2H, Y3H, B1H, B2H.

UNIT IV-Recent trends in molecular biology (12 Periods)

Targeted genome editing: ZFNs, TALENs, CRISPRs - Gene targeting: Knock-ins & Knock-out- DNA finger printing- microarrays- RNA interference as a reverse genetic approach.

UNIT V -Social issues in molecular technologies (16 Periods)

Public opinion against the molecular technologies. Legal issues – legal actions taken by countries for use of the molecular technologies. Ethical issues- ethical issues against the molecular technologies. Bioethics, different paradigms of bioethics-national and international. Intellectual Property Rights- Why IPR is necessary, TRIPS &IPR, IPR national and international scenario, IPR protection of life forms.

REFERENCES

1. Principles of gene manipulation and genomics (link is external) -7th Edition-Sandy B. Primorse, Richard Twyman –Blackwell publishing
2. Gene cloning DNA analysis: An introduction (link is external) -6th Edition –T.A. Brown-John Wiley & Sons
3. An introduction to Genetic Engineering (link is external) – 3rd Edition Desmond S.T. Nicholl- Cambridge University Press
4. Molecular Biotechnology: Principles and Applications of Recombinants DNA (link is external)- 4th Edition –Bernad R. Glick, Jack J.Pasternak, Cheryl L. Patten-ASM Press.

CORE COURSE: XIII

` **RESEARCH METHODOLOGY**

Semester : IV	**Max Marks : 75**
Course Code : 18PMB4C13	**Credit : 5***
Total Periods : 75	**Exam Hrs : 3**

Objectives:

The aim of the paper thus to strong foundation for the students to understand some basic concepts of research and its methodologies and to write a research report and thesis

UNIT I-Selection of Problem (15 Periods)

Stages in the execution of research, choosing a topic to publication - preparation of manuscript – report writing - format of journals-proof reading- sources of information: journals, reviews, books, monographs etc – bibliography.

UNIT II -Planning and Preparation of Thesis (15 Periods)

Research journals - National and International – monographs –Reprints – proof correction – full paper – shoot communication –Review paper

UNIT III-Biostatistics (15 Periods)

Scope – collection – tabulation and classification of data – probability analysis – Graphical diagrammatic representation – mean , median , mode.

UNIT IV-Standard Deviation (15 Periods)

Standard error – test of significance – t –test – chi – square test – ANOVA table – simple correlation – regression , confidence intervals of regression lines.

UNIT V-Organisation to Computer (15 Periods)

CPU – input and output device – memory – internal and external storage memory – knowledge about windows and its scientific applications (MS Office , PowerPoint , Excel) – retrieval of information from internet.

REFERENCES

1. Balagurusamy, E. 1985. Programming in Basic. 2nd Edition. *Tata McGraw Hill Publishing Co.Ltd.*,New Delhi.

2. Connor and Peter Woodford. 1979. Writing Scientific Paper in English. *Pitman.Medical Publishing Co,Ltd*. England.

3. Dheenadhayalu, R. 1987. Computer Science. Volume-1. *Tata McGraw Hill Publishing Co.Ltd.*, New Delhi.

4. Snedeer, G.W. and Cochran, W.G. 1978. Statistical Methods. *Oxford and IBH Publishing Co Pvt.Ltd.*

5. Zar. J.H. 1996. Biostatistical Analysis. Prentice Hall, Uppar Saddle River , New Jersey, USA.