

M.Sc. MICROBIOLOGY

SEM	COURSE CODE	COURSE	COURSE TITLE	HRS/ WEEK	CREDIT	CIA MARKS	SE MARKS	TOTAL MARKS
I	14PMB1C1	CORE I	Fundamentals of Microbiology	6	5	40	60	100
	14PMB1C2	CORE II	Microbial Physiology	6	5	40	60	100
	14PMB1C3	CORE III	Immunology and Immunotechnology	6	5	40	60	100
	14PMB1C4P	CORE IV	Fundamentals of Microbiology, Microbial Physiology, Immunology and Immunotechnology - Practical	6	5	40	60	100
	14PMB1CE1	CORE BASED ELECTIVE -I#		6	5	40	60	100
TOTAL				30	25	200	300	500
II	14PMB2C5	CORE V	Industrial Microbiology	6	5	40	60	100
	14PMB2C6	CORE VI	Bacteriology and Virology	6	5	40	60	100
	14PMB2C7	CORE VII	Medical Mycology and Parasitology	6	5	40	60	100
	14PMB2C8P	CORE VIII	Bacteriology and Virology, Medical Mycology and Parasitology - Practical	6	5	40	60	100
	14PMB2CE2	CORE BASED ELECTIVE – II #		6	5	40	60	100
TOTAL				30	25	200	300	500
III	14PMB3C9	CORE IX	Applied Microbiology	6	5	40	60	100
	14PMB3C10	CORE X	Microbial Genetics and Molecular Biology	6	5	40	60	100
	14PMB3C11	CORE XI	Recombinant DNA technology	6	5	40	60	100
	14PMB3C12P	CORE XII	Applied Microbiology, Microbial Genetics and Molecular Biology, Recombinant DNA technology - practical	6	5	40	60	100
	14PMB3CE3	CORE BASED ELECTIVE – III #		6	5	40	60	100
	14PMB3EC1	EXTRA CREDIT-I	Food and Nutrition	-	5*	-	100*	100*
TOTAL				30	25	200	300	500
IV	14PMB4C13	CORE XIII	Microbial Food Technology	6	5	40	60	100
	14PMB4C14	CORE XIV	Extremophiles	6	5	40	60	100
	14PMB4EC2	EXTRA CREDIT-II	Nutrition Management	-	5*	-	100*	100*
	14PMB4PW	PROJECT WORK	Dissertation	18	5	40	60	100
TOTAL				30	15	120	180	300
GRAND TOTAL				120	90	720	1080	1800

**Core Based Elective

SEMESTER	CORE BASED ELECTIVE
I	Pharmaceutical Chemistry
	Biomedical aspects of Microorganism
II	Clinical Lab Technology
	Mushroom and Vermitechnology
III	Microbial Biotechnology and Nanotechnology.
	Entrepreneurship Microbiology

*Not considered for Grand total and CGPA

SEMESTER I: CORE I

FUNDAMENTALS OF MICROBIOLOGY

Course Code : 14PMB 1C1

Hours/Week : 6

Credit : 5

Max marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To define key terms and describe the differences between bacteria, protists and fungi.
2. To know the principles of Microscopy including Light microscopes and Electron microscope.

UNIT I

18 hours

History and Scope of Microbiology: Discovery of Microbial World: Theories of Biogenesis and Abiogenesis. Contribution of scientists in the field of microbiology: Anton van Leeuwenhoek, Edward Jenner, Robert Koch, Louis Pasteur, Iwanowsky, Winogradsky, Beijerinck, Alexander Fleming, Selman Waksman, and Paul Ehrlich. #Scope and applications of Microbiology in various fields#.

UNIT II

18 hours

Study of Microscopy- Principle and Application of Bright field, Dark field, Phase contrast, Fluorescence, Electron Microscope- TEM and SEM, Polarized Microscope and Confocal Microscopy.

UNIT III

18 hours

Microbial Taxonomy: Definition, Systematics, Nomenclatural rules and Identification. Numerical taxonomy and phylogenetic tree. Classification systems of Microbial kingdom concept. Recent trends in Microbial taxonomy- #Classical characters and Molecular characters used in taxonomy#.

UNIT IV

18 hours

Diversity of Prokaryotes: General characteristics, Classification, Structure and Reproduction of Eubacteria, #Archaeobacteria, Mycoplasma,# Actinomycetes, Cyanobacteria, Prochlorophytes and Cyanelles.

UNIT V

18 hours

Diversity of Eukaryotes: General characteristics, Classification, Structure and Reproduction of Algae: Chlorophyta (Green algae), Diatoms, Rhodophyta (Red algae), Fungi: Ascomycetes (Aspergillus), Deuteromycetes (Candida), Zygomycetes (Mucor), Basidiomycetes (Agaricus) and Protozoa.

Self Study Portion

Text Books

1. Alexopoulos, C.J and Mims, C.W. Introductory Mycology (4th edition). Wiley East Ltd., New Delhi, 1988.
2. Cappuccino, J.G. and Sharman, N. Microbiology: A laboratory Manual (4th edition) Benjamin/Cummings Publication Company, California,1996.
3. Dubey, R.C and Maheshwari,D.K. A Textbook of Microbiology, S.Chand & Co. Ltd. NewDelhi, 2000.
4. Lansing, M. Prescott, John Harley, P. and Donald Klein, A.. Microbiology, Wm.C.Brown Publishers, Dubuque, USA, 1990
5. Michael,J Pelczar Jr, MJ. Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc, New York, 1986.

Books for Reference

1. Holt. J.S. Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Systematic Bacteriology (9th edition), Williams and Wilkins, Baltimore,1994.
2. John L. Ingraham and Catherine Ingraham, A. Introduction to Microbiology (3rd edition). Thomson Brooks/cole publication, 2004.
3. John Webster. Introduction to Fungi (2nd edition).Cambridge University press, Cambridge, 1993.
4. Michael, Madigan, T. John and Martinko, M. Brock Biology of microorganisms (11th edition) Pearson Education international, USA,2006.
5. Nester, E.W. Roberts, C.V. and Nester, M.T. Microbiology, A human perspective. IWOA, USA, 1995.
6. Tortora, G. J. Funke B.R and Case, C. L . Microbiology an Introduction (8th edition). LPE-Pearson Education, Inc, 2005.

Books for Study

UNIT I	Text Book 5	Chapter 1& 2
UNIT II	Text Book 5	Chapter 4
UNIT III	Text Book 5	Chapter 3
UNIT IV	Text Book 5	Chapter 13-16
UNIT V	Text Book 1	Chapter 2& 5, 6- 9 & 22

**SEMESTER I: CORE II
MICROBIAL PHYSIOLOGY**

Course Code : 14PMB 1C2

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To acquire principle knowledge on microbial growth and metabolism.
2. To understand the physiological regulatory mechanisms.

UNIT I

18 hours

Cell Structure and Function: Cell wall- introduction, types, Biosynthesis of peptidoglycan- outer membrane, teichoic acid, Exopolysaccharides, cytoplasmic membrane. #Flagella# and chemotaxis, pili, fimbriae and S-layer. Nutrient Transport mechanisms- uniport, symport and antiports- active, passive, facilitated diffusions and group translocation.

UNIT II

18 hours

Energy and Regulation: Energy and work-law of thermodynamics, spontaneity of reaction G , G° , G' and equilibrium. Role of ATP in metabolism- oxidation- reduction. Electron carriers- artificial electron donors, inhibitors, #uncouplers and energy bond#

UNIT III

18 hours

Microbial Growth: Nutrition, Nutritional types and Phases of growth. Synchronous growth, diauxic growth and continuous growth. Preservation methods- periodic transfer, mineral oil slant, liquid nitrogen, lyophilization and other preservative methods. #Factors affecting growth - pH, temperature, substrate and osmotic condition#. Cell division and endospore formation.

UNIT IV

18 hours

Microbial Pigments and Carbon Assimilation: Brief account of photosynthetic and their accessory pigments- chlorophylls, Carotinoids, Rhodopsin, Phycobilin proteins. #Fluorescence and phosphorescence#. Autotrophy- oxygenic and anoxygenic photosynthesis. Calvin cycle-C3-C4 pathways.

UNIT V

18 hours

Microbial Respiration and Fermentative Pathway: Aerobic metabolism-bringing nutrients into cell, catabolism- Embden Mayer Hoff pathway, Enter Doudroff pathway, Glyoxalate pathway, Krebs cycle and reverse TCA cycle. #Oxidative and substrate level Phosphorylation#. Biosynthesis- Gluconeogenesis, polymerization and assembly.

#--- # Self study

Text Books

1. Doelle, H.W. Bacterial Metabolism (2nd edition) Academic press, Elsevier Publication, New Delhi, India. 2005.
2. Madigan, M.T., Martinko, J.M. and Parker, J. Brock Biology of Microbiology (9th edition).

Prentice Hall International, USA. 2000.

3. Moat, A.G., Foster, J.W. and Spector, M.P. Microbial Physiology, (4th edition):

Wiley Publication, India. 2009

4. Pelczar M.J.R., Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc. New York, 1993.

5. Prescott, L.M., Harley, J.P. and Klein, D. Microbiology (7th edition). McGraw Hill, 2007

Books for Reference

1. Caldwell, D.R. Microbial Physiology and metabolism, Wm. C. Brown Publishers, (USA edition). LPE-Pearson Education, Inc, 1995
2. John L. Ingraham and Catherine A. Ingraham. Introduction to Microbiology (3rd edition). Thomson Brooks/Cole publication, 2004.
3. Gottschalk, G. Bacterial Metabolism (2nd edition) Springer - Verlag, Berlin. Hissar, Agricultural University, Prentice Hall of India Pvt. Ltd., Delhi, 1986.

Books for Study

1. UNIT I Text Book 2 Chapter 3
2. UNIT II Text Book 5 Chapter 8
3. UNIT III Text Book 5 Chapter 5&6
4. UNIT IV Text Book 1 Chapter 2
5. UNIT V Text Book 5 Chapter 9

SEMESTER I: CORE III

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Code : 14PMB 1C3

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives

1. To understand the key concepts on the role of immune system and immunological disorders
2. To Practically perform and interpret the Immunological techniques for diagnosis

UNIT I

18Hours

Elements of Immune system: History of Immunology, types of immunity- Innate, acquired and mucosal immunity. Cells and organs of immune system. Humoral and cell mediated immunity. Induction of immune response-Cytokines, lymphokines and chemokines.

UNIT II

18 hours

Antigens, Antibodies and Complement system: Antigens- properties and types. #Haptens, adjuvants and Mitogen (superantigens)#. Immunoglobulins-structure, properties, types and subtypes. Monoclonal antibody- production and their applications. Complement- Classical, Alternate and Membrane attack pathways.

UNIT III

18 hours

Major Histocompatibility Complex: Structure, function of MHC and HLA system. MHC Gene regulation. Lymphocyte receptor and cell signaling. Transplantation- organ transplantations in humans, HLA typing methods, Graft rejection- Graft disease (GVHD). Autoimmunity -systemic and organ specific. Hypersensitivity-types and mechanism.

UNIT IV

18 hours

Immunology in Relation to Tumour: Tumor antigens – immune response to tumors and functional classification. Immunodiagnosis of tumors – detection of tumor markers- alphafoetal proteins, carcino embryonic antigen. #Role of microorganisms in tumor. Immunotherapy of malignancy#.

UNIT V

18 hours

Immunological techniques and their principles: Antigen antibody interaction- Affinity, Avidity and epitope mapping. *In vitro* of immunological methods- agglutination, precipitation, complement fixation, neutralization, #Immunofluorescent antibody technique, ELISA, Radio immunoassays (RIA) and Flow cytometry#.

#--- # Self study

Text Books

1. Benjamin, E., Coico, R. and Sunshine, G. Immunology (5th edition). Wiley Publication, USA. 2003
2. Donal, M. Weir, John Steward. Immunology (8th edition). ELBS, London, 1993.
3. David male, Jonathan Brostoff, Roth, D.B. and Ivan Roitt. Immunology (7th edition) Mosy Elsevier publication, Canada. 2006.
4. Topley & Wilson's. Text Book on principles of Bacteriology, Virology and Immunology (8th edition). Edward Arnold, London, 1995.

Books for Reference

1. Ivan M. Roit . Essential Immunology – Blackwell Scientific Publications, Oxford, 1994.
2. Kuby J. Immunology (4th edition) – WH Freeman and Company, New York, 2001
3. Richard M. Hyde. Immunology (3rd edition) National Medical series, Williams and Wilkins, Harward Publishing company, 1995.

Books for Study

1. UNIT I Text Book 3 Chapter 1
2. UNIT II Text Book 3 Chapter 2
3. UNIT III Text Book 1 Chapter 9
4. UNIT IV Text Book 1 Chapter 19
5. UNIT V Text Book 1 Chapter 5

SEMESTER I: CORE -IV

FUNDAMANTALS OF MICROBIOLOGY, MICROBIAL PHYSIOLOGY, IMMUNOLOGY AND IMMUNOTECHNOLOGY - PRACTICAL

Course Code : 14PMB 1C4P

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To learn the principles and methodology for isolation and biochemical characterization of microorganism
 2. To know the concepts pertaining to microbial growth, and antigen antibody interaction techniques.
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1. Measurement of size of microbes - micrometry method.
 2. Motility determination - Hanging drop method and tube method.
 3. Pure culture techniques- dilution series spread plate, Streak plate and pour plate method.
 4. Isolation and identification of Actinomycetes, Cyanobacteria and Fungi.
 5. Staining methods- Simple, Gram staining, Negative, Acid fast, Endospore and Capsule stain.
 6. Measurement of growth curve- direct and indirect methods.
 7. Effect of pH and Temperature on microbial growth.
 8. Separation of amino acid by paper chromatography
 9. Biochemical tests: IMVIC, Catalase, Oxidase, TSI test, ONPG test, Nitrate reduction test, Starch Hydrolysis, Gelatin Hydrolysis, Casein and Urease test.
 10. Haemagglutination reaction- Blood grouping and Rh typing
 11. Latex agglutination- ASO.
 12. Precipitation reactions in gels- single radial Immunodiffusion, Double immunodiffusion- identity pattern
 13. Purification of Immunoglobulins: Ammonium sulphate precipitaion.
 14. Preparation of lymphocytes from peripheral blood by density gradient Centrifugation.
 15. Demonstration of ELISA.

Text Books

1. Aneja, K.R. Experiments in Microbiology, Plant pathology and Biochemistry (4th edition) New age International publishers, India, 2003.
2. Benjamin E, Coico R and Sunshine. Immunology a short (4th edition). Wiley Publication, 2000.
3. Cappuccino and James, G . Microbiology a laboratory manual, Addison Wesley Publishing Company Inc. (4th edition) England, California. 1996.
4. Chapel, H and Halbey, M. Essentials of Clinical Immunology, 1986.

Books for Reference

1. Gerhardt, P., Murray, R.G., Good, W.A. and Kreig, N.R. Methods for general and molecular bacteriology, ASM, Washington, 1994
2. Holt. J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Systematic Bacteriology (9th edition), Williams and Wilkins, Baltimore, 1994.
3. Wilson K. Walker. Practical Biochemistry, Principles and Techniques, Cambridge University Press, 1995.

**SEMESTER I: CORE BASED ELECTIVE I
PHARMACEUTICAL CHEMISTRY**

Course Code : 14PMB 1CE1

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To provide an overview on Biomolecules and their metabolism
2. To learn the techniques of Drug potential and toxicity

UNIT I

18 hours

Foundation of Biochemistry: Molecular logic of life, biomolecules-chemical composition, atoms, elements, bonding and its types, bond strength and interaction between biomolecules.[#] Basic concept of acid, base, pH, pKa value, buffer and water.

UNIT II

18 hours

Macromolecules: Carbohydrates: biological importance and classification. Monosaccharides – isomerism, anomerism. Disaccharides. Polysaccharides. Structures of starch and glycogen. **Protein-** aminoacids properties classification, structure of fibrous and globular proteins-primary, secondary, tertiary and quaternary structure. **Lipid**– Fats and fatty acid - β -oxidation and biosynthesis of cholesterol. **Nucleic acid** biosynthesis and degradation.

UNIT III

18 hours

Enzymes: General characteristics. Factors affecting enzyme activity. Regulation of enzyme activity. Enzyme kinetics, Km value. [#]Enzyme inhibition. Coenzymes and cofactors[#]. Therapeutic applications of Enzymes.

UNIT IV

18 hours

Microbial pharmaceuticals – Mechanism of action of anti- microbials. General properties and drug action of Sulphonamides. Antibacterial chemicals – Bactericidal and bacteriostatic agents. [#]Adverse drug reactions[#]. Principles of toxicity, evaluation and determination of LD 50, ED 50 and Therapeutic Index. [#]Quality for medicines and formulations[#] – British Pharmacopoeia and Indian Pharmacopoeia.

UNIT V

18 hours

Techniques in pharmaceuticals – Physical, chemical and biological screening methods to check drug purity. Extraction and purification procedure for drugs. Evaluation of the drug before marketing for drug safety and biomedical potential. Applications of drug evaluation in biological fluids. Routes of drug administration- volume of distribution – biotransformation – phase I and phase II reaction

#--- # Self study

Text Books

1. Donald Voet and Judith G. Voet . Biochemistry (2nd Edition). John Willey and Sons, Inc, 1995.
2. Lakshmi. S. Pharmaceutical chemistry (1stedition). Sultan Chand and Sons Publications, New Delhi, 1995.
3. Lehninger, David L.Nelson. Principles of Biochemistry (4th edition). Worth Publishers, NewYork, 1985.
4. Loewy,A.G.,Siekevitz,P.,Meninger,J.R.andGallant,J.A.N. Cell structure and function(3rd edition)Saunders college publication,USA,1991.
5. Murray,R.K.,Granner,D.K. and Rodwell,V.C.Harper's illustrated Biochemistry(27th edition)Mcgraw Hill publication,New Delhi,India.2006.
6. Purohit,S.S., Saluja,A.K. and Kakrani,H.N. Pharmaceutical Microbiology.Student edition, Jodhpur,India,2006.
7. Stryer, L. Biochemistry (4th edition) W.H. Freeman Company, New York, 1995

Books for Reference

1. Mathews, C.K. and Holde, K.E.V. Biochemistry (2nd edition). The Benjamin/ Cummings Publishing Company Inc. New York, 1985.
2. Purohit, S.S. Phamaceutical microbiology, 2003.
3. Rang, H.P., Dale, M.M.and Ritter, J,M. Pharmacology(4th edn.).Churchill Livingstone, New York, 1999.
4. Zubay, G.L., Puson, W.W. and Vance D.E. Principles of Biochemistry, WMC Publishers, Oxford, England, 1995.

Books for Study

1. UNIT I Text Book 4 Chapter 3
2. UNIT II Text Book 3 Chapter 1
3. UNIT III Text Book 7 Chapter 8
4. UNIT IV Text Book 6 Chapter 20
5. UNIT V Text Book 6 Chapter 34

SEMESTER I: CORE BASED ELECTIVE I
BIOMEDICAL ASPECTS OF MICROORGANISMS

Course Code : 14PMB 1CE1

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objectives:

1. To introduces basic principles of clinical relevance on Bacteriology ,Virology, Mycology and community infection.
2. It focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career

UNIT I

18 hours

Microbiology and medicine: History of Microbiology, Microbiology and medicine. Morphology and nature of microorganisms. #Bacterial classification and nomenclature#. Bacterial infections of body systems and tissues.

UNIT II

18 hours

Bacterial pathogens and associated diseases: Staphylococcus, Streptococcus, Pneumococcus. Salmonella, Mycobacterium, Leptospira, Vibrio cholera, Yersinia, Shigella, #Human Botulism, Human gas gangrene#.

UNIT III

18 hours

Viral Pathogens and associated diseases: Adenoviruses, Herpesviruses, Poxviruses, picornaviruses, Orthomyxoviruses, Paramyxoviruses, Retroviruses, Rhabdoviruses, Papovaviruses, Arboviruses. Animal viruses, Antiviral drugs.

UNIT IV

18 hours

Fungal pathogens and parasitic Infections: Mycotic disease of human and animals. Diagnostic procedure for fungi, Human dermatophytosis. Malaria; toxoplasmosis; cryptosporidiosis, Helminths; Filariasis.

UNIT V

18 hours

Diagnosis, Treatment and Control of Infection: Infective syndromes, Diagnostic procedures, Epidemiology and control of community infections. #Hospital infection, Prophylactic immunization#.

#--- # Self study

Text Books

1. David Greenwood, Richard Slack and John Peutherer . Medical Microbiology (15th edition) ChurchHill Living stone Publication, 2000.
2. Anathanarayanan and Paniker. Text book of Microbiology (8th edition). Orient Blackswan Publication, 2005.
3. Lansing, M. Prescott, John P. Harley and Donald A. Klein. Microbiology, Wm. C. Brown Publishers, Dubuque, USA, 1990.

Books for Reference

1. Jawetz, Melnick and Adelberg's . Medical Microbiology (22nd edition) McGraw Hill Medical Publication division, 2001.
2. Topley & Wilson's. Principles of Bacteriology, Virology and Immunity (8th edition) Vol. IV Virology, Edward Arnold, London, 1990.
3. Tortora G. J., Funke B. R and Case C. L. Microbiology - An Introduction (8th edition) LPE- Pearson Education, 2005.

Books for Study

UNIT I	Text Book 1	Chapter 1- 4 & 8
UNIT II	Text Book 1	Chapter 15,16,18,24,25,30,35,38
UNIT III	Text Book 1	Chapter 42-51
UNIT IV	Text Book 1	Chapter 60-63
UNIT V	Text Book 1	Chapter 64-69

SEMESTER II: CORE - V
INDUSTRIAL MICROBIOLOGY

Course Code : 14PMB 2C5

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objectives:

1. To provide the knowledge and interest on fermentation process and product recovery
2. Guide the student to design, develop and operate bioreactors.

UNIT I

18 hours

General concept of industrial microbiology- History and scope of industrial microbiology. Isolation and screening of industrially important microorganism. Strain improvement. #Types of industrial fermentation processes: Batch continuous, surface, submerged and solid state fermentation#.

UNIT II

18 hours

Fermentor Types and Processes - Fermentor: Basic structure, construction and various types-typical stirred aerated fermentor, tower fermentor, airlift fermentor and bubble cap fermentor. Downstream processing – precipitation – filtration, centrifugation, cell disruption and drying.

UNIT III

18 hours

Industrial Fermentation Process- Media components and formulation, crude media components, antifoam agents, precursors, inducer and inhibitors and buffering agents. Sterilization of media and raw materials. #Maintenance of sterility at critical points during fermentation.# Inoculum preparation.

UNIT IV

18 hours

Industrial production of primary metabolites - Raw material, organism and process involved in the alcohol production -Production of organic acids – Vinegar, Lactic acid, citric acid- #Alcoholic beverages- Beer and Wine production#.

UNIT V

18 hours

Industrial production of secondary metabolites- Production of antibiotics- Penicillin and Streptomycin, amino acid – L- Glutamic acid and L- Lysine. Enzymes– Amylase, Pectinase and Protease. Vitamins – Cyanocobalamine and Riboflavin.

#--- # Self study

Text Books

1. Casida L.E. Industrial Microbiology, Wiley Eastern Limited, New Delhi,2007.
2. Demain A.L, Davies, J.E. Manual of Industrial Microbiology & Biotechnology. ASM press, 1999.
3. Prescott, L.M, Harley, J.P, Klein, D.A . Microbiology , WCB Mc Graw Hill, 1999.
4. Wulf Crueger, Anneliese Crueger, Thomas D. Brock . Biotechnology: A Textbook of Industrial Microbiology, 1991.

Books for Reference

1. Baumberg. S., Hunter. I.S. and Rhodes, P.M. Microbial Products -New approaches. Cambridge Univ. Press. Cambridge,1989.
2. Prescott, S.C. and Dunn ,C.C. Industrial Microbiology, Tata McGraw-Hill Publishing Company limited, New Delhi.
3. Sikyta B. Methods in Industrial Microbiology, Ellis Horwood Limited,1983.
4. Stanbury, P.F. Whitaker, A and Hall,S.J. Principles of Fermentation Technology (7th edition) Elsevier Science limited Aditya Books Private Limited, New Delhi.

Books for Study

UNIT I	Text Book	1	Chapter 6
UNIT II	Text Book	2	Chapter 5
UNIT III	Text Book	2	Chapter 5
UNIT IV	Text Book	2	Chapter 8
UNIT V	Text Book	2	Chapter 12 & 13

**SEMESTER II: CORE VI
BACTERIOLOGY AND VIROLOGY**

Course Code : 14PMB 2C6

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To learn the pathogenesis and epidemiology of Bacteria and viruses.
2. To create awareness on Bacterial and Viral infection.

UNIT I

18 hours

Introductory to Bacteriology: Sample collection and transport of specimens– Blood, Urine, Sputum, CSF, Pus & Faeces – transport media and storage. Diagnosis –Microscopic examination of specimen for Bacterial pathogens. #Cultivation and isolation of viable pathogens – Media used – differential, selective, enrichment and enriched media#.

UNIT II

18 hours

Gram Positive Bacterial Diseases: Description of the pathogenesis, sample collection, Epidemiology, laboratory diagnosis and the treatment of following diseases-Anthrax, Meningitis, Diphtheria, Tuberculosis, Leprosy, Botulism, Tetanus, Syphilis, and Dental caries.

UNIT III

18 hours

Gram Negative Bacteria: Description of the morphology, Cultural characteristics, pathogenesis, sample collection, laboratory diagnosis and the treatment- #*E.coli*, *Klebsiella sp* #, *Salmonella sp*, *Shigella sp*, *Pseudomonas sp*, *Vibrio cholerae*, *Aeromonas hydrophila*, *Bordetella pertussis*, *Yersinia pestis* and *Neisseria spp*.

UNIT IV

18 hours

Basic concepts of Virology: Discovery, distinctive properties, morphology and Ultra structures, Classification, Cultivation and Purification assay of virus. Bacteriophages - structural organization and life cycle-lytic,lysogenic, DNA transcription and replication Antiviral agents - chemical and biological agents. #Viral related agents - viroids and prions#.

UNIT V

18 hours

Viral pathogenesis- Pathogenicity and Laboratory diagnosis of viral infections Hepatitis, Polio, Rabies, Measles, Mumps, Rubella and HIV. Emerging viral diseases like Chicken Guinea virus, Dengue virus, H1N1, SARS and Swine Flu Virus.

#--- # Self study

Text Books

1. Anathanarayanan,R and Jayaram Paniker,C.K. Text book of Microbiology (8th edition).University Press,Hyderabad,India. 2009.
2. Conrat H.F., Kimball P.C and Levy J.A. Virology (2nd edition).Prentice Hall , 1988.
3. David Greenwood, Richard Slack and John Peutherer . Medical Microbiology (15th edition) ChurchHill Living stone Publication, 2000.
4. Dimmock ,N.J., Easton,A.J. and Leppard,K.N. Introduction to Modern Virology, (6th edition) Blackwell Scientific Publications, Australia, 2007.
- 5.Purohit,S.S.Microbiology:Fundamental and Application(7th edition) Agrobiose publication,Jodhpur,India.2008.

Books for Reference

- 1.Tortora G. J., Funke B.R and Case C.L. Microbiology -An Introduction (8th edition) LPE-Pearson Education, Inc, 2005.
2. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, V.R. and Skalka. A.M. Principles of Virology, Molecular Biology, Pathogenesis and control, ASM Press, Washinton, 2000.
3. Jawetz, Melnickand Adelberg's. Medical Microbiology (22nd edition) McGraw Hill Medical Publication division ,2001.
4. Topley & Wilson's. Principles of Bacteriology, Virology and Immunity (8th edition) Vol. IV Virology, Edward Arnold, London, 1990.

Books for Study

1. UNIT I Text Book 1 Chapter 6
2. UNIT II Text Book 1 Chapter 3
3. UNIT III Text Book 1 Chapter 3
4. UNIT IV Text Book 5 Chapter 5
5. UNIT V Text Book 1 Chapter 4

SEMESTER II: CORE VII
MEDICAL MYCOLOGY AND PARASITOLGY

Course Code : 14PMB 2C7

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objectives:

1. To learn the pathogenesis and diagnosis of fungi and protozoan infections
2. To understand the concept of etiology and emerging fungi and protozoan disease

UNIT I

18 hours

Fundamentals of Medical Mycology: Basics of fungi - Morphology and classification of medically important fungi, Isolation Identification, and Transport of fungal specimens - Antifungal agents - sensitivity test –[#] NCCLS guidelines for antifungal testing - Agar & Broth dilution methods and mycotoxins[#].

UNIT II

18 hours

Mycosis Diseases: Superficial mycosis - Tinea, Piedra. Cutaneous mycosis - Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Systemic mycosis Blastomycosis and Histoplasmosis. Opportunistic mycosis - Candidiasis, Cryptococcosis and Aspergillosis. Emerging fungal diseases - [#]Zygomycosis and Candidemia [#]

UNIT III

18 hours

Ocular Mycology - Fungal keratitis, Endophthalmitis, - causative agents - Therapy, orbital fungal infections - Phycomycetes (Mucor & Rhizopus), Aspergillus, Ocular histoplasmosis - causative agent, therapy, Diagnosis of fungal infections of the eye - culture and molecular methods. Dental Mycology – Anaerobic dental plaques- Dental hygiene, Microbial flora of oral cavity, oral fungal infections - Oropharyngeal candidiasis, invasive fungi - Mucormycosis, [#]Allergic fungal sinusitis - aetiology, diagnosis, treatment and prognosis.

UNIT IV

18 hours

Introduction to Medical parasitology- parasite host and Vectors. Taxonomical classification of Protozoans and Helminths. Morphology, life cycle and lab diagnosis of lumen dwelling Helminths: *Enterobius vermicularis*, *T.trichura*, *Ascaris lumbricoids*, *Wuchereria bancrofti*, *Enterobius vermicularis*.

UNIT V

18 hours

Protozoan diseases: Life cycle, pathogenesis and prophylaxis of following diseases- Malarial parasites, liver fluke, [#]Entamoebiasis[#], Leishmaniasis, Giardiasis, Trichomoniasis, [#]Hook worm, [#] Cestodes and Trematodes.

#--- # Self study

Text Books

1. Anathanarayanan,R and Jayaram Paniker,C.K. Text book of Microbiology (8th edition).University Press,Hyderabad,India. 2009.
2. Cathleen park Talaro. Foundations in Microbiology (6th edition) McGraw Hill Medical Publication division, 2005.
3. Chatterjee. K.D. Medical Parasitology (7th edition) 2005.
David Greenwood, Richard Slack and John Peutherer . Medical Microbiology (15th edition) ChurchHill Living stone Publication, 2000.
4. Hobbs,B. Gupta,M.and William Russel. Medical Microbiology.Arnold publication,New Delhi,1991.

Books for Reference

1. Jawetz, Melnickand Adelberg's, .Medical Microbiology (22nd edition) McGraw Hill Medical Publication division, 2001.
2. John P. Harley. Microbiology Lab Manual (7thedition) McGraw Hill Medical Publication division Medical Books Publishers, New Delhi, 2007.
3. Prescott, Harley, Klein's. Microbiology (7th edition) McGraw Hill Medical Publication division, 2007.
4. Subhas Chandra Parija . Text book of Medical Parasitology(2nd edition).2004.

Books for Study

1. UNIT I Text Book 4 Chapter 7
2. UNIT II Text Book 1 Chapter 5
3. UNIT III Text Book 2 Chapter 14
4. UNIT IV Text Book 3 Chapter 5
5. UNIT V Text Book 5 Chapter 12

SEMESTER II: CORE VIII

BACTERIOLOGY AND VIROLOGY AND MEDICAL MYCOLOGY PARASITOLGY - PRACTICAL

Course Code : 14PMB 2C8P

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objective

To expand the knowledge on isolation of pathogens and biochemical disorders in human beings.

1. Isolation and identification of certain pathogenic microbes from – wound, pus, sputum and urine.
2. Testing sensitivity of bacteria to antibiotics.
3. Assessing Minimum Inhibitory concentration and Minimum bactericidal concentration of antibiotics.
4. Germ tube test and KOH mount for fungal pathogen
5. Wet mount and Iodine test for Cyst
6. Blood smear for MP- demonstration
7. Blood cell counts-Total RBC Count, WBC and Platelet Count.
8. Differential count.
9. Erythrocyte sedimentation rate
10. Packed Cell Volume.
11. Hemoglobin content of blood.
12. Estimation of Serum sugar
13. Estimation of Serum cholesterol.
14. Estimation of SGOT and SGPT.

Text Books

1. Balows, A., Hausser Jr. K.L., Isenberg, H.D., Shalomy, H.J .Manual of Clinical Microbiology, ASM, Washington, 1991.
2. Cappuccino and Sherman.. Microbiology: A Laboratory manual by (7th edition) Berjamin cummings publications, 2004.
3. Gerhardt, P., Murray, R.G., Wood, W.A. and Kruz, N.R. Methods for General and Molecular Bacteriology, ASM, Washington , 1994.

Books for Reference

1. Karen Messley. Microbiology Lab manual (2nd Edition) Berjamin cummings Publisher,2003.
2. Lorian, V. Antibiotics in laboratory medicine (3rd edition) Williams and Wilkins, Baltimore, 1991.

**SEMESTER II: CORE BASED ELECTIVE -II
CLINICAL LAB TECHNOLOGY**

Course Code : 14PMB 2CE2

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objective:

1. To improve the student knowledge on clinical lab techniques pertaining to their skill

UNIT I

18 hours

Introduction-Human health and medical care, organization and role of clinical labs, safety regulations. Laboratory equipments and applications, #quality control of laboratory findings#.

UNIT II

18 hours

Introduction of hematology: Definition of blood , composition of blood (cells, plasma /serum)Formation of blood: Erythropoiesis, Leucopoiesis and Thrombopoiesis Anticoagulants and it types.# Morphology of normal blood cells: Normal morphology, morphology in diseases. Normal and absolute values in hematology: RBC count , WBC count ,Platelet count ,DLC value, Hb , MCH ,MCV ,MCHC , ESR, PCV.

UNIT III

18 hours

Blood Banking: Basic Principles of Blood Banking, Introduction, Organization & Planning, Documentation, Blood groups , blood transfusion and transfusion reactions. The Compatibility Test, Major & Minor Cross Match, Coomb's Test. Blood film: Different types , Methods of preparation, Staining Romanwsky stains : #Principle of staining , Different stains ,their composition and preparation , method of staining#.

UNIT IV

18 hours

Hematological disorder: Laboratory tests for assessing bleeding disorders- bleeding time and Clotting time. Laboratory investigation for disseminated intravascular coagulation(DIC) Mechnaism of fibrinolysis test for fibrinolysis. #Platelet function tests and their interpretation#.

UNIT V

18 hours

Histopathology: Theory of Histopathology, Reception of specimens, Histopathology of Tumor cell. Method of preparing stains & Fixatives.Theory of Tissue processing and embedding. Theory of H & E staining .Use of Microtome, Tissue section cutting. Embedding and preparation of blocks Fixation of Tissue with DPX mount Theory of frozen section preparation.Preparation of smear for Fine needle aspiration cytology. Techniques available for cytogenetic studies.

#--- # Self study

Text Books

1. Andrew Blann, Gavin knight and Gray moore. .Haematology. Oxford University Press, 2010.
2. Barbara J.Bain. Blood cells. Wiley Black well Publication,2006.
3. Kanai L Mukherjee. Medical laboratory technique.Vol 1& 2(2 edition), Tata McGraw Hil Education Private Ltd, New Delhi, 2010.
4. Ronald M. Atlas, Lawrence C.Pazis. Hand book of Microbiological Media. Ed.LC. CRC Press, London. 1993.

Books for Reference

1. Balows, A., Hauser Jr. K.L., Isenberg, H.D., Shalomy, H.J. Manual of Clinical Microbiology, ASM, Washington, 1991.
2. Gerhardt, P., Murray, R.G., Wood, W.A. and Kruz, N.R.Methods for General and Molecular Bacteriology, ASM, Washington, 1994.
3. Victor, A.H., Daniel Catovsky, Edward, GD. Tuddenham, and Anthony R. Green. Postgraduate Haematology. Wiley-Blackwell Publication, 2010.
4. Lorian, V. Antibiotics in laboratory medicine(3rd edition). Williams and Wilkins, Baltimore, 1991.

Books for Study

UNIT I	Text Book 3	Chapter 2
UNIT II	Text Book 2	Chapters 2 & 3
UNIT III	Text Book 2	Chapter 1 & 7
UNIT IV	Text Book 4	Chapters 4
UNIT V	Text Book 3	Chapter 36- 38

**SEMESTER II: CORE BASED ELECTIVE -II
MUSHROOM AND VERMI TECHNOLOGY**

Course Code : 14PMB 2CE2

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To provide knowledge on application of mushrooms and vermi composting
2. To promote the students to become an entrepreneurship

UNIT I

18 hours

Introduction, History and Scope: Edible mushroom cultivation – Types of edible mushroom available in India – *Calacybe indica*, *Volvariella Volvacea*, [#]*Pleurotus sp*[#], [#]*Agaricus bisporus*[#]

UNIT II

18 hours

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 saline bottle and polypropylene bags and their multiplication.

UNIT III

18 hours

Cultivation Technology : Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood – inoculation loop – low cost stove – sieves – Culturel rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, [#]banana leaves[#].

UNIT IV

18 hours

Selection of suitable species: Epiges (*Eisenia foetida*), Endoges (*Eudrilus eugeniae*), Aneciques. Basic characteristics of suitable species. [#]Role of earthworms in soil structure, fertility and productivity.

UNIT V

18 hours

Vermicompost preparation: Vermicomposting materials – preliminary treatment of composting material – Requirement for vermicomposting – small scale vermicomposting – large scale vermicomposting – collection of vermicompost. Decomposition of Biodegradable wastes – [#]Vermiculture in pollution Abatement.

#--- # Self study

Text Books

1. Edwards, C.A and Bohlen, P.J . Biology and ecology of earthworms III Edn. Chapman & Hall publications N.Y.U.S.A, 1996.
2. Shu-Ting Chang, Philip G. Miles, Chang, S.T. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2nd ed, CRC press, 2004.

Books for Reference

1. Arvind kumar, .Vermitechnology , Aph publishing corporation,2005.
2. Marimuthu. Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore, 1991.
3. Mary violet Christy . A . Vermitechnology,Mjp publishers, 2008.
4. Nita Bahl. Hand book of Mushrooms, II edition, Vol.I & II, 1988.
5. Paul Stamets, J.S. and Chilton, J.S. Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press, 2004.
6. Swaminathan M. Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore, 1990.
7. Tewari and Pankaj Kapoor S.C. Mushroom cultivation, Mittal Publications, Delhi, 1988.

Books for Study

UNIT I	Text Book 2	Chapter 2 &11
UNIT II	Text Book 2	Chapter 10
UNIT III	Text Book 2	Chapter 13
UNIT IV	Text Book 1	Chapter 10& 11
UNIT V	Text Book 1	Chapter 12

SEMESTER III: CORE IX
APPLIED MICROBIOLOGY

Course Code : 14PMB 3C9

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To understand the vital role and application of microorganisms on soil and agricultural field.
2. To learn the microbial processes on Bioleaching and treatment of waste materials.

UNIT I

18 hours

Soil Microbiology: Soil Microbiology-Structure, Types, Physical and Chemical properties. Soil microbes-Types and Enumeration-Weathering and Humus formation, Soil pollution. Biogeochemical cycling-Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance. Interactions among microorganisms- #Mutualisms, Commensalism, Competition, Amensalism, Parasitism and Predation#.

UNIT II

18 hours

Biogeochemical cycles: Microbial Interaction among plants, #Rhizosphere, and Phyllosphere#. Phytopathogens-Bacterial, Fungal, Viral diseases (Wilt, Blight, Canker, Mosaic)-Control measures. Biogeochemical cycles and Microorganisms – Nitrogen cycle, Carbon cycle, Sulfur cycle, Phosphorous cycle and Iron cycle.

UNIT III

18 hours

Biological Nitrogen fixation: Biological Nitrogen fixation. Nif gene and their regulation in *Klebsiella* and *Rhizobium*. Biofertilizers - Characteristics, Production and application of *Rhizobium*, *Azotobacter*, *Azospirillum*, #Blue green algae#, *Azola*, Phosphate solubilizing bacteria and Mycorrhizae.

UNIT IV

18 hours

Recycling of Liquid and Solid wastes: Characterisation and types of liquid waste management and treatment- Primary, Secondary treatment and Tertiary treatment. Characterization and types of solid waste-solid waste management and treatment- Silage, Pyrolysis and saccharification. #Composting and Biogas process and production#.

UNIT V

18 hours

Environmental Application: Deterioration of paper, leather, wood textiles and pharmaceutical products. Bio degradation of complex polymer-cellulose, hemicelluloses, and lignin. Microbial leaching-copper and uranium. Xenobiotics degradation -Heavy metals, Radionuclides, Recalcitrants and Halogenated compounds. Application of GIS and RS techniques in Environmental Monitoring.

#--- # **Self study**

Text Book

1. Agrios, G.N. Plant Pathology (2nd edition). Academic Press NY,1978.
2. Ainsworth, G.C. Introduction to the history of plant pathology Cambridge, Univ. Press, Cambridge,1981.
3. Alexander, M. Microbial Ecology. John Wiley and Sons Inc. NY,1971..
4. Atlas R.M and Bartha, R. Microbial Ecology Fundamentals and Application (4th edition) - LPE , pearson Education.Inc, 2005.
5. Baker, K.F. and Cook ,R.J. Biological control of plant pathogens. W.H. Freeman and Co, 1974.
6. Dirk J, Elas V, Trevors JT, Wellington, EMH. Modern Soil Microbiology. Marcel Dekker INC, New York, Hong Kong, 1997.
7. Eldowney, S., Hardman, DJ., Waite, DJ.and Waite, S. Pollution: Ecology and Biotreatment. Longman Scientific Technical, 1993.
8. Pelczar M.J.R., Chan, E.C.S. and Kreig, N.R. Microbiology, McGraw Hill. Inc. New York, 1993

Books for Reference

1. Forster, C.F. Biotechnology and Wastewater Treatment. Cambridge Uni. Press. Cambridge, 1985.
2. Grant WD, Long PL. Environmental Microbiology. Blackie Glasgow. London, 1981.
3. Gray, N.F. Biology of waste water Treatment. Oxford University Press Oxford, 1989.
4. Rai, MK. Handbook of Microbial biofertilizers. Food Products Press, New York, 2005.

Books for Study

UNIT I	Text Book 8	Chapter 25
UNIT II	Text Book 8	Chapter 25
UNIT III	Text Book 8	Chapter 5
UNIT IV	Text Book 8	Chapter 27
UNIT V	Text Book8	Chapter 36

SEMESTER III: CORE X

MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Course Code : 14PMB 3C10

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To provide key concepts on Gene and DNA
2. To understand the principles on classical and molecular genetics
3. To provide an idea about research on molecular genetics

UNIT I

18 hours

Nucleic Acids: Introduction, properties, [#]structure and types of Nucleic acid – DNA, RNA and PNA[#]. Nucleic acid as a genetic material-Griffith, Blender jar experiment, Avery experiment, RNA as a genetic material, Beadle and Tatum experiment. Genetic code- general features, wobble hypothesis, Code is triplet – Molecular evidence. Transposable elements.

UNIT II

18 hours

Maintenance of Genetic Information: DNA replication- basic rules, Semi conservative model- Meselson and Stahl experiment, replication of circular DNA molecule, Discontinuous replication, Bi directional replication, Rolling circle mechanism. DNA damage and repair mechanism.

UNIT III

18 hours

Gene transfer mechanisms: Horizontal gene transfer Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation– Hfr, triparental mating, [#]self transmissible and mobilizable plasmids and pili[#].

UNIT IV

18 hours

Mutation and their biochemical basis: Mutation and mutagenesis- Definition and types- Spontaneous mutation and induced mutation. Expression of mutation and Mutagenesis- base analog, intercalating agents and mutator genes. [#]Detection, isolation, characterization of mutant and their uses[#]. Ames test for mutagenicity.

UNIT V

18 hours

Molecular aspect of gene expression: Organization of Gene and gene expression in Prokaryotes and Eukaryotes- Transcription and translation . Gene rearrangement by RNA and DNA splicing. Gene regulation in prokaryotes: Operon concept- Lac and Trp operon..

#--- # Self study

Text Books

1. Benjamin, L. Gene (4th edition). Oxford Univ. Press, Oxford, 1990.
2. Brown, T.A. Essential Molecular Biology - A Practical approach. Vol-1, Oxford Univ. Press. Oxford, 1991.
3. David, J., Ulley and Eckstein, F. Nucleic Acids and Molecular Biology. Vol-6 Springer-verlag Berlin Heidelberg, 1992.
4. Desmond, S.T., and Nicholl. An Introduction to genetic Engineering Cambridge Univ. Press. Cambridge, 1994.
5. Freifelder, D. Microbial genetics (2nd edition). Narosa Pub. Home. India, 1990.
6. Gardner, E.J. Principles of Genetcis. John Wiley and Sons Inc. NY, 1991.
7. Steller, P. and Bianchi,D.E.Cell and molecular biology(3rd edition)Wiley publication.India,2009.
8. Rastogi,V.B. Fundamentals of molecular biology. Ane books publication, India.2008.

Books for Reference

1. Halvorson, HO., Pramer, D. and Rogul, M . Engineered Organisms in the Environment. Scientific Issues. American Society for Microbiology, Washington,1985.
2. Lewin B. Genes VII. Oxford University press, 2000.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann. Molecular Biology of the Gene (5th edition) The Benjamin/cummmgs Publishing Company Inc. NY, 1987.
4. Primrose, S.B. Principles of Gene Manipulation (4th edition) Black Well Scientific Pub. London, 1989.
5. Watson, JB., Gflnian, M., Witkowshi, J. and Zoller, M. Recombinant DNA(2nd edition) Scientific American Books, 1992.

Books for Study

1. UNIT I Text Book 7 Chapter 7
2. UNIT II Text Book 5 Chapter 9
3. UNIT III Text Book 8 Chapter 14
4. UNIT IV Text Book 6 Chapter 2
5. UNIT III Text Book 5 Chapter 12&13

SEMESTER III: CORE XI
RECOMBINANT DNA TECHNOLOGY

Course Code : 14PMB 3C11

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives

1. To improve the knowledge on recombinant DNA technology and applications in advanced Molecular Biology research.
2. To gain information on tools involved in genetic manipulation of organisms

UNIT I

18 hours

Introduction to Biotechnology: Definition, history and achievements. Vectors- Plasmid vectors: pBR322 and pUC19. Bacteriophages vectors - M13 vector and Lambda vector. Phagemids, Cosmids and Shuttle vectors. #Artificial chromosomes - YACs, BACs and HACs#.

UNIT II

18 hours

Enzymes in Biotechnology: #Restriction enzymes (Type I, II and III) # - role of Ligases, Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, DNA Polymerases, Taq DNA polymerases, RNase, Reverse transcriptase. #Linkers, Adaptors & Homopolymer tailing#.

UNIT III

18 hours

Gene manipulation. Safety guidelines of r-DNA research. Trnasfection- Gene manipulation in animals- Knockout mice and its application, gene transfer in Drosophila, gene transfer in plants- protoplast, Particle bombardment, macro injection and T DNA mediated Gene transfer in Bacteria- physical and chemical methods.

UNIT IV

18 hours

rDNA technology– cloning strategies-Gene Library construction-shotgun cloning, cDNA cloning and PCR cloning. Screening of recombinants, Insertional inactivation - genetic complementation and hybridization - colony and plaque. Blotting technique- Southern, Northern and Western blotting. Analyzing DNA - PCR, inverse PCR, RT-PCR and Microarray analysis.

UNIT V

18 hours

rDNA Application –# Molecular probes production, labeling and applications#. sequencing by chemical and enzymatic method –Production of Insulin , human growth hormone and Recombinant vaccines. Introduction to Gene therapy (in vivo & ex vivo), Antisense therapy. DNA finger printing (RFLP, RAPD&AFLP).

#--- # Self study

Text Books

1. Glick, B.R. and Pasternak, J.J. . Molecular Biotechnology (2nd edition) ASM press, Washinton DC., 2003.
2. Ghosh, T.K. Bioprocesses, Computation in Biotechnology. Vol-I Euis Harwood NY, 1990.
3. Halvorson, H.O., Pramer, D. and Rogul, M. Engineered Organisms in the Environment. Scientific Issues. American Society for Microbiology, Washington. NY, 1985.
4. Old, R.W. and Primrose, S.B. Principles of Gene Manipulation (4th edition). Black Well Scientific Pub. London, 1989.
5. Rastogi, V.B. Fundamentals of molecular biology. Ane books publication, India. 2008.
6. Wilson, K. and Walker, J. Principles and techniques of biochemistry and molecular biology (6th edition) Cambridge University Press, NY, 2008.

Books for Reference

1. Peppier, H.J and Prelman, D. Microbial Technology and Fermentation Technology. Vol.1 and II. Academic Press. NY. 1979.
2. Sussman, S.C.H. Coflms, F.H, Skimmer and Stewartful, D.E. The release of genetically engineered microorganisms. Academic Press, London, 1988.
3. Ward, O.P. Fermentation Biotechnology: Principles, Processes and products. Prentice Hall Engle wood Cliffs New Jersey, 1989.
4. Watson, J.B., Gflnian, M., Witkowshi, J. and Zoller, M. Recombinant DNA. (2nd edition). Scientific American Books, 1992.
5. Watson, J.D., Hopkins, N.H., Roberts, J.W.. Steitz, J.A and Weiner, A.M. Molecular biology of the gene (4th edition) Benjamin/cummings Publishing Company Inc. NY, 1987.

Books for Study

1. UNIT I Text Book 1 Chapter 4&5
2. UNIT II Text Book 5 Chapter 16
3. UNIT III Text Book 1 Chapter 3
4. UNIT IV Text Book 6 Chapter 6
5. UNIT V Text Book 5 Chapter 16

SEMESTER III: CORE XII

APPLIED MICROBIOLOGY, MICROBIAL GENETICS AND MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY - PRACTICAL

Course Code : 14PMB 3C12P

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objectives

1. To understand the principles and methodology of experiments on environmental microbiology
2. To train and develop the skills on Molecular Biology experiments
 1. Localization and staining of Vesicular and Arbuscular Mycorrhizae
 2. Isolation and culturing of *Rhizobium* from root nodules of leguminous plant.
 3. Isolation of cellulase producing microbes from soil
 4. Isolation and identification of air-borne bio-particles.
 5. Effect of high salt concentration on microbial growth.
 6. Algae as indicators of water pollution.
 7. Determination of BOD of polluted / pond water.
 8. Determination of COD of polluted / pond water.
 9. Assessment of water quality by MPN technique.
 10. Scoring of mutants through physical and chemical agents.
 11. Isolation and Characterization of plasmid DNA
 12. Isolation of chromosomal DNA
 13. Quantification of DNA by DPA method
 14. Restriction digestion of DNA
 15. DNA amplification- PCR analysis
 16. Total protein estimation – Lowery *et al* method
 17. Principle and separation of protein gel electrophoresis (SDS PAGE).
 18. Isolation of Protoplast and Spheroplast.

Text Books

1. Aaronson, S . Experimental Microbial Ecology, Academic Press, New York, 1970.
2. Aneja, K.R. Experiments in Microbiology, Plant pathology and Biochemistry(4th edition)New age International publishers, India, 2003.
3. Atlas, R.M and Brotha .R. Microbial Ecology Fundamentals and Application (4th edition) - LPE pearson Education.Inc,2005..
4. Clesceri, L.S, Greenberg, A.E, Eaton,A.D. Standard methods for examination of water & waste water , American Public Health Association,1998.
5. Collins, C, Lyne, P.M .. Microbiological Methods ,Butteworths , London, 1985.
6. Dharmalingam, K. Experiments with MI3 gene cloning and DNA sequencing, Published by Wasani for MacMillan India Limited, 1986.

Books for Reference

1. Forster, C.F. Biotechnology and Wastewater Treatment. Cambridge Uni. Press. Cambridge, 1985.
2. Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. Methods of General and Molecular Bacteriology, Ed. American Society for Microbiology, Washington, 1994.
3. Gray, N.F. Biology of waste water Treatment. Oxford University Press Oxford, 1989.
4. Marshall, K.C. Advances in Microbial Ecology. Vol.8, Plenum press, 1985.

SEMESTER III: CORE BASED ELECTIVE III
MICROBIAL BIOTECHNOLOGY AND NANOTECHNOLOGY

Course Code : 14PMB 3CE3

Max Marks : 100

Hours/Week : 6

Internal Marks: 40

Credit : 5

External Marks: 60

Objectives

1. To provide knowledge on microbial products and its uses.
2. To enable the students to use the bioinformatics tools on biomolecules.
3. To create awareness on bio nanoparticles and patenting

UNIT I

18 hours

Modern trends in microbial production: Bioplastics – PHB and PHA. Biopolymer- Dextran, Alginate and Xanthan. Biotransformation of Steroids, Methanogenesis, Bioluminescence and Mushroom Cultivation. Commercial products obtained from microorganisms –[#]Single cell protein and β – Carotene[#].

UNIT II

18 hours

Bioinformatics: Introduction to bioinformatics – Classification of Biological data bases-Nucleic acid data base- Protein data base. Biological Sequence analysis – Pairwise sequence comparison – Sequence queries against biological databases – BLAST and FASTA - Multiple sequence alignments - Phylogenetic alignment. Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

UNIT III

18 hours

Bio Nanotechnology: Introduction– Classification of Nanostructures -1D, 2D and 3D. applications of nano biomaterial- Polymeric implant materials: Polyolefin; polyamides (nylon); Acrylic polymers (bone cement) and hydrogels; Fluorocarbon polymers; [#]Deterioration of polymers[#].

UNIT IV

18 hours

Bio Nanoparticles: Bio synthesis of nanoparticles- Biomineralization, Magnetosomes, Nanoscale magnetic iron minerals in bacteria, virus & fungi. Nanoparticles for Drug Delivery: Nanoparticles surface modification, bioconjugation, pegylation, antibodies, cell-specific targeting and controlled drug release, Multi-Functional Gold Nanoparticles for Drug Delivery: Virus Based-nanoparticles.

UNIT V

18 hours

IPR and Biosafety: Good manufacturing practices. [#]Hazard analysis and critical control points (HACCP) [#].GATT and IPR, forms of IPR, IPR in India, WTO Act, Convention on Biodiversity(CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Indian and international agencies involved in IPR & patenting of biological material. Bio hazard and safety level.

#--- # Self study

Text Books

1. Arora, P.N and Malhon P.K. Bioinformatics. Himalaya Publishing house. Mumbai, India, 1996.
2. Christef M. Niemeyer, C. A. Mirkin. Nanobiotechnology: Concepts, Application and Properties. Wiley – VCH Publishers, New York, 2004.
3. Cruger, W. and Cruger, A. Biotechnology: A text book of industrial Microbiology (2nd edition) Panima publication, India, 2004
4. Demain, A.L , Davies, J.E. Manual of Industrial Microbiology & Biotechnology, ASM press, 1999.
5. Mani, K. and Viyaraj, N . Bioinformatics for beginners, Kalai kathir Achchagam, coimbatore, India, 2002.
6. Mick Wilson, Kamali Kannangara . Nanotechnology: Basic science and emerging technologies. Overseas Press 2005.
7. Purohit, S.S. Biotechnology: Fundamentals and application (4th edition) Agrobios publication, India, 2010.
8. Ramsden, J.J. Bioinformatics: An Introduction. Springer publication. New Delhi, India, 2006.

Books for Reference

1. Rashidi, H. and Buehler, H . Bioinformatics basic: Application in biological science and medicines, CRC press, London, 2002.
2. Ratner, M. and Ratner, D. Nanotechnology: A Gentle Introduction to the Next Big idea. Pearson Education, Inc. NJ, USA, 2005.
3. Reinert, J. and Bajaj, Y.P.S. Plant cell, tissue and organ culture. Narosa Publishing house, New Delhi, India, 1997.
4. Vasanth patabi and Gautham. N . Biophysics. Narosa Publication, New Delhi, India, 2004.

Books for Study

1. UNIT I Text Book 3 Chapter 16&19
2. UNIT II Text Book 8 Chapter 3
3. UNIT III Text Book 7 Chapter 42
4. UNIT IV Text Book 7 Chapter 43
5. UNIT V Text Book 4 Chapter 12

**SEMESTER III: CORE BASED ELECTIVE III
ENTREPRENEURSHIP IN MICROBIOLOGY**

Course Code : 14PMB 3CE3

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To involve the development and depth knowledge about the product and its marketing.
2. To inculcate in students the entrepreneurial and problem solving attitude.
3. To discover the factors that lead individuals to entrepreneurship

UNIT I

18 hours

Evolution of the concept of Entrepreneur : Entrepreneurship: Definitions – concept of Entrepreneurship, development – need – role of resource, talent and spirit – process of Entrepreneurship to socio – economic gains.

UNIT II

18 hours

Institutions and schemes of government of India: Schemes and programmes, Department of science and technology schemes, Nationalized banks – #other financial institutions etc# – SIDBI – NSIC – NABARD – IDBI – IFCI – ICICI etc.

UNIT III

18 hours

Skills for Entrepreneurs – communication skills, problem solving skills; Business plan development; Market need – market research, SWOT analysis, identify your competition. Financial plan – obtain financing for your business, insure your business, # Marketing – mix – product, distribution, price, promotion, and set marketing goals#.

UNIT IV

18 hours

Composting: domestic waste, #agricultural and industrial waste, vermi – composting#. SCP production – mushroom cultivation.

UNIT V

18 hours

Biofertilizers and Biopesticides: #Production of teaching kits (plasmid DNA isolation, serum electrophoresis) # and diagnostic kits (WIDAL test kits, ABO blood grouping kits)

#--- # Self study

Text Books

1. Anilkumar S, Poornima S, Abraham NK. Entrepreneurship Development. New Age Pub. INDIA, 2009
2. Harley, J.L. and Smith, S.E. Mycorrhizal Symbiosis. Academic Press, London, 1983.
3. Marks, G.C. and Koslowski, T.T. Ectomycorrhizae, Academic Press. London, 1973.
4. Nandan H. Fundamentals of Entrepreneurship. 3rd edn, PHI Learning pub, INDIA, 2013
5. Rao, N.S. Biofertilizers in Agriculture. Oxford and IBH Publishing Co. Pvt. Ltd., Bombay, 1980.
6. Rao, N.S. Venkataraman, G.S. and Kannaiyan. Biological N₂ fixation. ICAR Publications, New Delhi, 1983.

Books for Reference

1. Sandera, F.E., Mosse, B. and Tinke, P.B. Endomycorrhizae. Academic Press, London, 1975.
2. Thompson, L. M. and Fredrick, T. Soils and Soil Fertility. Tata Mc Graw-Hill Publishing Co., New Delhi, 1979.
3. Venkataraman, G.S. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's Printers and Publishers, New Delhi, 1972.

Books for Study

1. UNIT I Text Book 1 Chapter 6
2. UNIT II Text Book 4 Chapter 14
3. UNIT III Text Book 1 Chapter 12
4. UNIT IV Text Book 3 Chapter 12
5. UNIT V Text Book 2 Chapter 5 & 8

SEMESTER III: EXTRA CREDIT-I
FOOD AND NUTRITION

Course Code : 14PMB3EC1

Hours/Week : --

Credit : 5*

Max Marks : 100*

Internal Marks: --

External Marks: 100*

Objectives:

1. To learn nutrition and the various foods necessary for a well-balanced day's menu.
2. To know the distribution, metabolic function and deficiency micro and macro elements.

UNIT I

18 hours

Sources, food composition, properties and storage of common foods. Functions of food in relation to health- classification of foods based on nutrients. New protein, new fat foods. Food preservation- food additive in processed food and their effects. Food groups to provide nutritive requirement for normal health- body building foods, energy foods and protective foods.

UNIT II

18 hours

Essential nutrients: Fats, carbohydrates and proteins. Energy value of foods, energy needs. Definition of unit of energy- cal, RQ, SDA, NPU, Basal metabolism- measurement- factors influencing BMR. # Role of fibre in diet.

UNIT III

18 hours

Micro and macro mineral nutrients: Distribution sources, metabolic functions and deficiency manifestations – Ca, P, Na, K, Fe, Cu, Se, Zn. Vitamins- classification, distribution, source functions, hyper and hypovitaminosis. # Water distribution- maintenance of water and electrolyte balance#.

UNIT IV

18 hours

Nutrition through life cycle. Infants, children, adolescents, pregnant, # lactating women and old persons#.

UNIT V

18 hours

Principles of diet therapy. Diet during stressed conditions- laborers. Patients- therapeutic diets for anemia, malnutrition, obesity, # diabetes mellitus and allergy#.

#--- # Self study

Text Books

1. Heimann, W. Fundamentals of food chemistry . Ellis Horwood Publishers, 1980.
2. Swaminathan M. Essentials of food and nutrition, 1974.

Books for Reference

1. Justin Healey. Food and Nutrition. Spinney Press, 2008.
2. Geoffrey Campbell Platt. Food Science and Technology. Wiley Blackwell Publishers, 2009.

Books for Study

1. UNIT I Text Book 2 Chapter
2. UNIT II Text Book 1 Chapter
3. UNIT III Text Book 1 Chapter
4. UNIT IV Text Book 1 Chapter
5. UNIT V Text Book 2 Chapter

SEMESTER IV: CORE XIII
MICROBIAL FOOD TECHNOLOGY

Course Code : 14PMB 4C13
Hours/Week : 6
Credit : 5

Max Marks : 100
Internal Marks: 40
External Marks: 60

Objectives:

1. To gain knowledge about the extrinsic and intrinsic parameters that affect bacterial growth.
2. To familiarize the primary sources of microorganisms in meat, poultry and vegetable products as well as the establishment's environment.
3. To create awareness about food contamination and food borne illness

UNIT I

18 hours

Food as substrate for microorganisms: Microorganisms important in food microbiology- Molds, yeasts and Bacteria- General characteristics- classification and importance. Principles of food preservation- physical, chemical preservatives and food additives. # Factors influencing Microbial growth in food- Extrinsic and Intrinsic factors#.

UNIT II

18 hours

Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products- Fish and sea food- spoilage of canned foods. # Detection of spoilage and characterization#.

UNIT III

18 hours

Food-borne infection and intoxications: Bacterial and non bacterial- with examples of infective and toxic types- *Brucella*, *Bacillus*, *Clostridium*, *Salmonella*, *Escherichia*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Camphylobacter*, Nematodes, Protozoa, algae, fungi and viruses.

UNIT IV

18 hours

Industrial Food fermentations: Starter cultures and their biochemical activities, production and preservation of the following fermented foods- Soy sauce fermentation by Moulds - Fermented vegetables – Sauerkraut - Fermented Meat – Sausages - # Production and application of SCP and Baker's products in food industry.

UNIT V

18 hours

Dairy Microbiology: Probiotics and Prebiotics use of *Lactobacilli*, homo and heterolactic fermentations and their therapeutic and nutritional value. # Microbiology of fermented milk products -acidophilus milk and yoghurt#.

#--- # Self study

Text Books

1. Adams M.R. and Moss MO. Food Microbiology, The Royal Society of Chemistry, Cambridge, 1995.
2. Andrews A.T, Varley J. Biochemistry of milk products. Royal Society of Chemistry, 1994.
3. Banwart G.J. Basic food microbiology, Chapman & Hall, New York, 1989.
4. Edward Harth, J.T. Applied Dairy Microbiology. Marcel Decker Inc. New York, 1998.
5. Frazier W.C and Westhoff DC. Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi, 1988.
6. May J.M. Modern Food microbiology, CBS Publishers and distributors, New Delhi, 1987.

Books for Reference

1. Hobbs B.C and Roberts D. Food poisoning and food hygiene, Edward Arnold (A division of Hodder and Stoughton), London, 1993.
2. Robinson R.K. The microbiology of milk. Elsevier Applied Science, London, 1990.

Books for Study

- | | | |
|----------|-------------|----------------------|
| UNIT I | Text Book 5 | Chapter 1 |
| UNIT II | Text Book 5 | Chapter, 11-15,18&19 |
| UNIT III | Text Book 5 | Chapter 24 |
| UNIT IV | Text Book 1 | Chapter 9 |
| UNIT V | Text Book 7 | Chapter 7 |

**SEMESTER IV: CORE XIV
EXTREMOPHILES**

Course Code : 14PMB 4C14

Hours/Week : 6

Credit : 5

Max Marks : 100

Internal Marks: 40

External Marks: 60

Objectives:

1. To know about the habitat and adaptation strategies of living microbes in all extreme origin.
2. To distinguish the features of extremophiles.

UNIT I

18 hours

Basic of extremophiles: Concept of Extremophiles v/s conventional Microbial forms and Archaeobacteria. Physiological features, Adaptation strategies of Anearobes, Barophiles, Cryophiles and Thermophiles. #Culturable and unculturable microbes#.

UNIT II

18 hours

Thermophiles: Classification, Hyperthermophilic- habitats and ecological aspects. Extremely Thermophilic Archaeobacteria, Thermophily, commercial aspects of thermophiles. Applications of thermozymes. Methanogens-Classification, Habitats, applications. Microbial ecosystem in Volcano.

UNIT III

18 hours

Halophiles and Barophiles: Classification, Dead Sea, discovery basin, cell walls and membranes – Purple membrane, compatible solutes. Osmoadaptation / halotolerance. Applications of halophiles and their extremozymes. Barophiles: # Classification, high-pressure habitats, life under pressure, barophily, death underpressure#.

UNIT IV

18 hours

Alkalophiles and Acidophiles: Introduction, Classification and application of alkaline environment- soda lakes and deserts, calcium alkalophily. Acidophiles- Introduction, # Classification and application- life at low pH and acid tolerance. Psychrophiles and cave Microbiology#.

UNIT V

18 hours

Space microbiology: Aims and objectives of Space research. Life detection methods- Evidence of metabolism (Gulliver) - #Evidence of photosynthesis (autotrophic and heterotrophic)-ATP production- Phosphate uptake and Sulphur uptake#. Martian environment (atmosphere, climate and other details). Antarctica as a model for Mars. Search for life on Mars, Viking mission, Viking landers and Biology box experiment.

#--- # **Self study**

Text Books

1. Thomas D Brock. Thermophiles. General, Molecular and Applied Microbiology. Wiley Interscience Publication,1986.

Books for Reference

1. Clive Edward. Microbiology of Extreme Environments. Open University Press. Milton Keynes publication,1990.
2. Johri B.N. Extremophiles. Springer Verlag, New York, 2000.
3. 3.Kushner ,D.J. Microbial Life in Extreme Environments.Academic Press,London, 1978.
4. Madian M.T., Martinko JM and Parker J Brock T.D. Biology of Microorganisms (8th edition) Prentice Hall International Inc. London, 1997.
5. Michael, T. Madigan, John M. Martinko. Brocks Biology of Microorganisms (8thedition). Prentice Hall International Inc.1997.

Books for Study

UNIT I	Text Book 1	Chapter 5
UNIT II	Text Book 1	Chapter 5
UNIT III	Text Book 1	Chapter 5
UNIT IV	Text Book 1	Chapter 5
UNIT V	Text Book 1	Chapter 4

**SEMESTER IV: EXTRA CREDIT II
NUTRITION MANAGEMENT**

Course Code : 14PMB 4EC2

Max Marks : 100*

Hours/Week : --

Internal Marks: --

Credit : 5*

External Marks: 100*

Objectives:

1. To gain knowledge about the healthful diet and maintaining a healthy body.
2. To familiarize the diet and weight should address the individual behavior.
3. To create awareness about nutrient intake and nutritional disorder.

UNIT I

18 hours

Principles of Nutrition - Nutrients and their functions. Food groups, meal planning, RDA, Over nutrition, under nutrition, # malnutrition#.

UNIT II

18 hours

Nutrition during pregnancy and lactation. Important of Nutrition during pregnancy. Complication in pregnancy, # food and nutritional requirements for lactating women#.

UNIT III

18 hours

Nutrition for infants and preschoolers. Importance of breast milk, food and nutritional requirements for infants, weaning and supplementary foods for infants, food habits of preschoolers, # nutritional requirements for preschool children#.

UNIT IV

18 hours

Nutrition for school age and adolescents. Nutritional requirements for school going children and adolescents, factors influencing food intake, nutritional disorders.

UNIT V

18 hours

Nutrition during adulthood and old age. Food and nutritional requirements for adults. Importance of nutrition during old age, # factors influencing food intake, nutritional requirements, nutritional problems and management of old age#.

#--- # Self study

Text Books

1. Davidson, Sri Stanley Passmore, R and Brock, J.H.Heeman. Nutrition and Dietetics, F.F.S.Livingstons Ltd., Edinduragt London, 1973.
2. Gopalan, C. and Balasubramanian, Diet Atlas of India, NIN, Hyderabad, 1971.
3. .Gopalan, C.Ramasastry, B.V. and Balasubramanian, S.C. Nutritive value of India foods, NIN, Hyderabad, 1976.

Books for Reference

1. Swaminathan, M. Essentials of Food and Nutrition Vol.I & II BAPPCO., Bangalore Printing and Publishing co., ltd., No.88, Mysore Road, Bangalore, 2002..

Books for Study

1. UNIT I Text Book 1 Chapter
2. UNIT II Text Book 1 Chapter
3. UNIT III Text Book 2 Chapter
4. UNIT IV Text Book 3 Chapter
5. UNIT V Text Book 3 Chapter

**SEMESTER IV: PROJECT WORK
DISSERTATION**

Course Code : 14PMB 4PW
Hours/Week : 30
Credit : 15

Max Marks : 100
Internal Marks: 40
External Marks: 60

Objectives:

1. The aim of project work is to inculcate students to learn an adequate knowledge on research skills and specialize in their field of interest.
2. To bring an ideal platform for broadening student technical skills, writing of thesis and publications.
3. It aims to bridges students respectively with national research institutes and Industries