

SEMESTER – I PRINCIPLES OF MICROBIOLOGY - PMB701**Unit - 1:****(15 Hrs)**

Scope of Microbiology - History - Microscopy - types - Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy - Stains and dyes – staining methods - Structure of bacterial cell - Structure and functions of cell organelles

Unit - 2:**(15 Hrs)**

Classification - Haeckel's, Whitaker's - Evolution of microorganisms - Outline of bacterial classification according to Bergey's manual – Polyphasic taxonomy – 16s rRNA gene based phylogeny – Mol % G+C analysis – Chemotaxonomic markers – fatty acid methyl esters, peptidoglycans – Conventional and molecular methods of studying microbial diversity

Unit - 3:**(15 Hrs)**

Fungi – characteristics, morphology, reproduction, physiology, classification – Lichens – Algae - occurrence, importance, characteristics, classification – Protozoa - occurrence, free-living, symbiotic, morphology, reproduction, classification – Viruses - general characteristics, morphology, multiplication – cultivation - classification – viruses of bacteria, plants, animals, human beings – Viroids, Prions - Rumen Microbiology

Unit - 4:**(15 Hrs)**

Nutritional requirements of microorganisms - Growth factors - Nutritional types - Culture media - Sterilization - Physical agents - High temperature, Low temperature, Desiccation, Osmotic pressure, Radiation, Filtration - Chemical agents - Phenols and phenolic compounds, Alcohols, Halogens, Heavy metals and their compounds, Dyes, Synthetic detergents, Quaternary ammonium compounds, Aldehydes, Gaseous agents - Antibiotics - Classification, Mode of action – Antifungal and antiviral agents.

Unit - 5:**(15 Hrs)**

Microbial growth – Growth curve - Measurement of microbial growth – Batch and Continuous culture - Synchronous growth - Sporulation - Bacterial reproduction - Uptake of nutrients – Simple, Passive, Facilitated diffusion, Active transport, Group translocation - Principles of energetics – oxidation-reduction reactions – respiratory chain – Energy production by anaerobic process (Glycolysis, Pentose phosphate pathway, ED Pathway, Fermentation) - Energy production by aerobic process (TCA, catabolism of lipids, catabolism of proteins, respiration without oxygen, heterotrophic CO₂ fixation, glyoxylate cycle) Energy production by photosynthesis (cyclic, non-cyclic) - Mechanism of ATP synthesis – Bioluminescence

Text Books

- Prescott, L. M., J. P. Harely and D. A. Klain, Microbiology, 2003 (5th Edition) McGraw Hill, New York.
- Atlas R. A. Principles of Microbiology (2nd Edition), 1997. Wm. C. Brown Publishers, Iowa.

Reference Books

- Salle A. J., Fundamental Principles of Bacteriology, 1974 (TMH Edition), Tata McGraw Hill Publishing Company, New Delhi.
- Moat, A.G. and J. W. Foster. Microbial Physiology, III Edition. Wiley - LISS, A John Wiley & sons. Inc. Publications, 1995.

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**SEMESTER – I IMMUNOLOGY AND IMMUNOTECHNOLOGY
- PMB702**

Unit - 1:**(15 Hrs)**

History of Immunology – Overview of the immune system - Cells and organs of the immune system - Antigens - types, property, haptens, adjuvants, vaccines -Immunoglobulins - structure & classes

Unit - 2:**(15 Hrs)**

Immunohaematology - Blood groups, blood transfusion, Rh incompatibilities - Antigen-Antibody reactions - Agglutination, Precipitation, Complement fixation, Immunofluorescence, ELISA, RIA

Unit - 3:**(15 Hrs)**

Host-Parasitic relationships - Microbial infections - Virulence and host resistance - Innate and acquired immunity – vaccines – Definitions & Types - Brief account of MHC molecules – Antigen processing and presentation – T-cell receptors – T-cell maturation, activation and differentiation – B-cell generation, activation and differentiation - Cell mediated Immunity – Lymphokines and Cytokinins

Unit - 4:**(15 Hrs)**

Complement pathways - Classical and Alternate pathways - Hypersensitivity -Type I, II, III and IV - Basic concepts of Autoimmunity – Brief account of autoimmune diseases – Immunodeficiency – Transplantation immunology – immunological basis of graft rejection, Immunosuppressive therapy - Cancer and the immune system – oncogenes, tumors of the immune system, tumor antigens, immune response to tumors, cancer immunotherapy

Unit - 5:**(15 Hrs)**

Antibody production - Production of antisera – Haemagglutination titre and assay for antibody secreting cells – Separation and Identification of protein or antigen – Hybridoma technology: Monoclonal antibodies – Antibody engineering – Gene transfer technology – SCID Mice and SCID – human mice – Bone marrow transplantation – Tissue culture – Other techniques contributing to immunotechnology

Text Books

- Goldsby, R.A., T. J. Kindt and B. A. Osborne, Kuby Immunology, 2000 (4th Edition) W. H. Freeman and Company, New York.
- Tizard, I. R. Immunology. 1995 (4th Edition), Saunders College Publishing.

Reference Books

- Roitt, I. M. Essential Immunology, (8th Edition), Blackwell Science.
- Mark Peakman and Diego Vergani. 1st magazine, 1997, Basic and Clinical Immunology. Churchill Livingstone, New York.

SEMESTER – I MOLECULAR BIOLOGY AND MICROBIAL GENETICS - PMB703**Unit - 1:****(15 Hrs)**

Nucleic Acids – Components of Nucleic acids – The double helix – Denaturation and melting curves – Renaturation – Circular and superhelical DNA – the structure of RNA – Nucleases – Methods used to study macromolecules – isolation of nucleic acids – determination of the base sequence of DNA. - Chemical and Physical structure of a polypeptide chain.

Unit - 2:**(15 Hrs)**

DNA replication – the basic rule for replication of all nucleic acid – the geometry of DNA replication – Enzymology of DNA replication – Discontinuous replication – Bidirectional replication – Rolling replication – DNA damage and repair – Biological indications of damage to DNA. Biological Indication of Repair – biochemical mechanisms for repair of thymine - Mutations and Mutants – Isolation of mutants – Genetic analysis of mutants – Mutagenesis – Reversion – Suppression – Plasmids - Types – Detection of plasmids – purification of plasmid DNA – Transfer of plasmid DNA – Plasmid replication – Partitioning of plasmid replicas at cell division – properties of particular bacterial plasmids.

Unit - 3:**(15 Hrs)**

Transposable elements – Insertion sequences – detection of transposition in bacteria – types of bacterial transposons – Transposition – Transposons and evolution. - Molecular aspects of gene expression – gene expression – Transcription – messenger RNA – Translation – the genetic code – overlapping genes – polypeptide synthesis – complex translation units - Regulation of gene expression – common modes of regulation – the E. coli Lactose system and the operon model – the tryptophan operon, a biosynthetic system. Autoregulation

Unit - 4:**(15 Hrs)**

Bacterial Transformation – the discovery of transformation, detection of transformation – competence – DNA uptake – molecular mechanism of transformation – mapping by transformation. - Bacterial Conjugation – Hfr Transfer, Recombination in recipient cells – properties of systems lacking recombination proteins – the RecA, B, C proteins and their function – chromosome transfer in bacteria other than E. coli

Unit - 5:**(15 Hrs)**

Bacteriophages – General properties life cycle – counting phage – properties of a phage- infected bacterial culture – specificity in phage infection. Host restriction and modification - Phage genetics I: phage T4 – Phage mutants, Genetic mapping of phage T4, features of the T4 life cycle. Phage genetics II: phage λ – λ DNA and its gene organization, outline of the life cycle of λ , λ DNA replication and phage production, recombination in the λ life cycle. Phage genetics III: Lysogeny – Immunity and repression – lysogenization and prophage insertion – prophage excision – Polylysogeny. Phage genetics IV: Transduction – DNA transfer by means of transduction – cotransduction and linkage – mapping by cotransduction – properties of specialized transducing particles.

Textbooks

- Freifelder, D., Microbial Genetics. 1987, Narosa Publishing House, New Delhi.
- Streips, U. N. and R. E. Yasbin, Modern Microbial Genetics, 2002 (2nd Edition), Wiley-Liss, Inc., New York.

Reference Books

- Benjamin Lewin, Gene VII, 7th Edition, Oxford University Press.
- Twyman, R M., Advanced Molecular Biology – A concise Reference, 1998, Viva Books Private Ltd., New Delhi.

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SEMESTER – I ENVIRONMENTAL MICROBIOLOGY - PMB704**Objective:**

To make the students understand the importance of microbes in ecology and bioremediation.

Unit - 1: (15 Hrs)

Microbiology of air - droplet nuclei, aerosols - enumeration of microorganisms in air- air sanitation - Laboratory hazards - airborne diseases - Aquatic microflora - lakes, ponds, rivers, ocean, estuary, ground water -significance – study of aquatic microflora – Eutrophication - Waterborne diseases

Unit - 2: (15 Hrs)

Waste water treatment - primary, secondary (anaerobic and aerobic - trickling, activated sludge, oxidation pond) - Sludge digestion - Disposal - Drinking water treatment - chlorination - Microbiological standards of water - Water pollution - indicators water pollution - BOD – COD - techniques for the study of water pollution

Unit - 3: (15 Hrs)

Role of microbes in soil fertility - methods used in soil microbiology – Deep subsurface Microbiology - Biodegradation of pesticides and pollutants in soil - Biogeochemical cycles - carbon, phosphorus, sulfur, iron, and nitrogen cycles – Green house effect and microorganisms

Unit - 4: (15 Hrs)

Interaction among microbial populations (Neutralism, commensalism, synergism, Mutualism, competition, parasitism, antagonism) – Microbial interaction with plants – rhizosphere, mycorrhizae, phyllosphere, nitrogen fixation - Microbial interaction with animals – microbial contribution to animal nutrition – symbiotic relationship

Unit - 5: (15 Hrs)

Bioremediation – recovery of metals – bioaccumulation of metals - acid-mine drainage - Biodeterioration – biofouling – Biofilms – Composting – Quantitative microbial ecology – sample collection, detection of microbial populations, determination of microbial numbers and biomass

Textbooks

- Atlas & Bartha, Microbial Ecology - Fundamental and Applications, 1998, Benjamin/ Cummings Publishing Company, Inc., California
- Joseph C. Daniel. Environmental Aspects of Microbiology, 1996, Brightsun Publications, Chennai.

Reference Books

- Mitchell, R (ed) Environmental Microbiology. 1992, John Wiley, New York.
- Grant W. D. and Long P.E., Environmental Microbiology, 1981 Blackie and Son Ltd., Glasgow

SEMESTER – I METHODS IN BIOLOGY EPMB705S**Objective:**

To make the students familiar with techniques routinely used in bio sciences

Unit 1:**(6 Hrs)**

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy

Unit 2:**(6 Hrs)**

Biophysical methods: structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods

Unit 3:**(6 Hrs)**

Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines

Unit 4:**(6 Hrs)**

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

Unit 5:**(6 Hrs)**

Methods in field biology: Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods.

Textbooks

- Boyer, R. Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997.

Reference Books

- Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

SEMESTER – I PMBP 101 LAB COURSE – I

**SEMESTER – II FOOD AND AGRICULTURAL MICROBIOLOGY
- PMB806**

Unit - 1: (15 Hrs)

Importance of studying food and dairy microbiology - Microorganisms important in food microbiology - Food as a substrate for microorganisms - Factors affecting the kinds and number of microorganisms in food - Contamination and spoilage - Food preservation methods with principles physical irradiation, drying, heat processing - high temperature - low temperature - chilling, freezing, high pressure, modification of atmosphere - food additives - chemical sodium chloride, sugar, vinegar, class I and class II preservatives

Unit - 2: (15 Hrs)

Food fermentations - therapeutic and nutritional value of fermented foods - Milk and milk products - fermented dairy products - butter, cheese, yogurt, acidophilus milk - Spoilage and defects of fermented dairy products - Milk-borne infection, intoxication - Milk preservation methods - pasteurization, sterilization

Unit - 3: (15 Hrs)

Food poisoning and food borne infections by bacteria such as Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, fungi and viruses; bacterial and fungal exo- and endo- toxins - Food borne disease outbreaks - laboratory testing - preventing measures - Food sanitation - Plant sanitation - quality control - HACCP - Food control agencies and its regulations

Unit - 4: (15 Hrs)

Plant pathogenic microorganisms - Microbial Diseases of plants - disease symptoms, - mode of entry of pathogens - Plant disease resistance - factors affecting disease incidence - control measures

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Unit - 5:**(15 Hrs)**

Plant Diseases – Examples -Bacterial Diseases: Bacterial Blight of Paddy, Citrus Canker - Mycoplasma Diseases: Rice Yellow Dwarf, Fungal Diseases: Late Blight of Potato, Downy Mildew of Maize, Rust of Wheat, Wilt of Cotton, Leaf Spot of Turmeric, Blast disease of Rice, Mango Anthracnose - Viral Diseases: Leaf Curl of Tomato, Yellow Vein Mosaic of Bhendi – Nematode Diseases: Ear – Cockle of Wheat.

Text Books

- Frazier W. C. and D.C, Westhoff, Food Microbiology, 1988 (4th Edition), Tata McGraw Hill Publishing Company Ltd., New Delhi.
- G. Rangaswami, A. Mahadevan. Diseases of crop plants in India 4th Edition. 1999, Prentice - Hall of India Private Ltd., New Delhi.

Reference Books

- Doyle, M. P., L. R. Beuchat and T. J. Montville. Food Microbiology -Fundamentals and Frontiers, 2001 (2nd Edition), ASM Press. Washington, D.C.
- G. Rangaswami, D. J Bagyaraj, Agricultural Microbiology 2nd Edition,1998, Prentice - Hall of India Private Ltd., New Dethi.

SEMESTER – II FERMENTATION TECHNOLOGY - PMB807**Objective:**

To make the students familiar with microbiological techniques in fermentation industry.

To make the students understand the application of microbes in fermentation industry.

Unit - 1:**(15 Hrs)**

Historical development of bioprocess technology, outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets - General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes - asepsis and containment requirements - body construction and temperature control - aeration and agitation systems - **sterilization of fermenter**; Design of sterilization equipment - aseptic inoculation methods - sampling methods, valve systems - monitoring and control devices and types of fermenters - An overview of aerobic and anaerobic fermentation processes and their application in the biotechnology industry, solid-substrate fermentation and its applications.

Unit - 2:**(15 Hrs)**

screening and strain development strategies - preservation of industrially important microorganisms - Fermentation media - Desired qualities - Medium requirements for fermentation processes, Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, media formulation strategies - formulation of optimal growth and product formation, examples of simple and complex media - role of buffers, precursors, inhibitors, inducers and antifoams - design and usage of various commercial media for industrial fermentations, heat, sterilization of liquid media - thermal death kinetics of microorganisms - filter sterilization of liquid media, Air.

Unit - 3:**(15 Hrs)**

Downstream process - Objectives and criteria - foam separation - precipitation methods - filtration devices and filter aids - industrial scale centrifugation and cell disruption methods - liquid-liquid extraction - solvent recovery - chromatography - two-phase aqueous extraction - super-critical fluid extraction - ultrafiltration, drying devices, crystallisation and whole broth processing- Fermentation economics

Unit - 4:**(15 Hrs)**

Stoichiometry of Cell growth and product formation, degrees of reduction of substrate and biomass, yield coefficients of biomass and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth - Phases of cell growth in batch cultures, product formation kinetics, substrate and product inhibition on cell growth and product formation.

Unit - 5:**(15 Hrs)**

Important industrial fermentations - production of enzymes (amylase, pectinases, cellulase) - Amino acid production (glutamic acid and lysine) - Production of antibiotics (penicillin, tetracycline) - Production of Vitamins (riboflavin, cyanocobalamin) - Production of alcohol (Ethanol) and beverages (beer and wine) - Organic acids - lactic acid, citric acid - Steroid transformations - Production of Vaccines, toxoids, antitoxin

Text Books

- Stanbury. P.F., A.Whitaker and S.J. Hall, Principles of fermentation Technology, 1995 (2nd Edition), Butterworth - Heinemann (Pergamon), Oxford.
- Reed, G, Prescott & Dunn's Industrial Microbiology, 1982 (4th Edition), CBS Publishers Distributors, Delhi.

Reference Book

- Crueger W. and A Crueger. Biotechnology, 2000 (2nd Edition), Panima Publishing Corporation, New Delhi.
- Waits, M.J., N.L. Morgan and G, Higton. Industrial Microbiology; An Introduction, 2001, Blackwell Science, Oxford.

SEMESTER – II CLINICAL MICROBIOLOGY - PMB808

Unit - 1: (15 Hrs)
Background to infectious diseases – Host-parasite relationship – Types of transmission – Specimen collection - Specimen quality – Diagnosis of infection.

Unit - 2: (15 Hrs)
Clinical manifestations and diagnosis of infections by body system – Upper respiratory tract infections – Infections of the eye – Lower respiratory tract infections – Urinary tract infections – Sexually transmitted diseases.

Unit - 3: (15 Hrs)
Gastrointestinal tract infections – Obsteric and perinatal infections – Central nervous system infections – Infections of the skin, muscle, joints, bone and hemopoietic system.

Unit - 4: (15 Hrs)
World wide virus infections (Measles, Mumps, Rubella, Cytomegalovirus infection, EBV infection, other human herpes virus infections and small pox) – Vector borne infections (Rickettsial diseases, Malaria, Dengue as examples) – Multisystem Zoonoses – Pyrexia of unknown origin – Infections in the compromised host.

Unit - 5: (15 Hrs)
Epidemiologic aspects of the control of infection and disease – Hospital acquired infection, sterilization and disinfection - Nucleic acid techniques in Diagnostic Microbiology.

Text Books

- Ananthanarayanan, R and C.K.J. Panicker. Text Book of Microbiology, 2000 (6th Edition), Orient Longman Private Ltd., Chennai.
- Mims, C.A., Mims' Pathogenesis of Infectious Diseases. 1995 (4th Edition), Academic Press, London.

Reference Books

- Brooks, G.F., Janet S. Butel, Stephen A, Jawetz, Melnick & Adlerberg's Medical Microbiology, 21st Edition, Prentice Hall International Inc. 1998.
- Murray. P.R., G.S, Kobayashi, M.A. Pfaller and K. S. Rosenthal, Medical Microbiology, 1993, (2nd Edition), Mosby St. Louis.

SEMESTER – II BIOTECHNOLOGY - PMB809**Unit - 1: (15 Hrs)**

History, Scope and Definitions of Biotechnology - **Industrial Biotechnology** - Enzyme technology - Enzyme immobilisation, Products, Applications - Biotechnological potentials of Seaweeds, Microalgae - Single cell protein - Mushroom - Spirulina cultivation - Biotransformation

Unit - 2: (15 Hrs)

Plant Biotechnology - Plant tissue culture - callus culture - cell culture - protoplast culture - Somatic hybridization - Production of haploid plants - Somoclonal variations - Micropropagation - germ plasm conservation - Cryopreservation

Unit - 3: (15 Hrs)

Animal Biotechnology - animal cell culture - facilities and applications - culture media for animal cells - biology of cultured cells - primary culture and cell lines - scale-up - cell viability and cytotoxicity - cell transformation and cell cloning - organ and histotypic cultures - tissue engineering - Biohazards

Unit - 4: (15 Hrs)

Environmental Biotechnology - Biotechnological methods for environmental monitoring - Recalcitrant xenobiotics - Biodegradation (hydrocarbons, pesticides, herbicides) - Bioremediation - contaminated soils - marine oil pollutants - Biofuel - Production of Hydrogen gas as fuel from Microorganisms

Unit - 5: (15 Hrs)

Biotechnology and Society - Benefits of Biotechnology - Ethical, legal and social issues of Biotechnology - Patents - GATT and IPR - WIPO - History of Indian Patent System, Patent Administration in India - Patentable subject, Patents filing - Geographical indications - Bioethics - Peoples perception about Genetically modified products, GM foods, Genetically engineered organisms, release of GM into the environment - Ethical issues associated with cloning, genome sequencing, stem cell research

Text Books

- Gupta, P.K., Elements of Biotechnology, 1996, Rastogi and company, Meerut.
- Satyanarayana, U. Biotechnology. 2005. Books and Allied (P) Ltd., Kolkata

Reference Books

- Balasubramanian, D., C.F.A. Bryce., K. Dharmalingam, J. Green and K. Jayaraman, Concepts in biotechnology, 1996, Universities Press (India) limited, Hyderabad.
- Glick, B.R. and J.J. Pasternack, Molecular Biotechnology, Panima Publishing Corporation, New Delhi, Bangalore, Indian Edition.

SEMESTER – II RESEARCH METHODOLOGY - EPMB810S**Unit 1: (6 Hrs)**

Research – Definition – Literature Collection – Literature Citation – Experimental designs - Major search engines - Major Websites, book and scientific information - Identification, Selection and formulation of research problem – Research questions

Unit 2: (6 Hrs)

Research Report – Components of a Research Report – Authors and Addresses – Abstract – Synopsis – Key words – Introduction – Materials and Methods – Results – Discussion – Acknowledgements – Summary and Conclusions – Appendixes – References - Title – Tables – Figures – Formatting and Typing.

Unit 3: (6 Hrs)

Biological research - Institutional Ethical committee - Animal ethical committee - Use of laboratory animals in research - Laboratory animal management

Unit 4: (6 Hrs)

General Laboratory Procedures – pH, Buffers, Electrodes and Biosensors – Estimation of Carbohydrates(Bradford Method) – Protein(Lowry Method) – Lipid (Soxlet Method) – Nucleic Acid (Spectrophotometry) – Techniques for Sample Preparation.

Unit 5: (6 Hrs)

Centrifugation – Principles and Instrumentation - Low-Speed centrifuges – High-Speed Centrifuges – Ultracentrifuges. Applications of Centrifugation: Preparative Techniques – Analytical Centrifugation (Differential and Density gradient)

Text Books

- Dr. N. Gurumani, Research Methodology: For Biological Sciences, 2006, MJP Publishers.
- Upadhyay, Upadhyay and Nath, Biophysical Chemistry Principles and Techniques, Himalaya Publications, 1997.

Reference Books

- Y. K. Singh and R. B. Bajpai, Research Methodology Data Presentation, 2008, APH Publishing Corporation, New Delhi.
- Rodney Boyer, Modern Experimental Biochemistry (3rd Edition) 2000. Addison Wesley Longman, Inc.
- Wilson and Walker, A Biologists guide to Principles and Techniques of Practical Biochemistry (5th Edition) 2000 Cambridge University Press.
- David Freifelder, Physical Biochemistry, (2nd Edition) 1982, W. H. Freeman and Company, New York.

SEMESTER – II LAB COURSE – II PMBP 202

St. Joseph's College, Cuddalore.