



# बिलासपुर विश्वविद्यालय, बिलासपुर (छत्तीसगढ़)

पाठ्यक्रम सत्र 2017-18

एम.एस.सी.पूर्व माइक्रोबायोलॉजी

## PAPER- I BACTERIOLOGY

- UNIT-1 Morphology and ultra structure of bacteria-** morphological types- cell walls of arch bacteria, gram negative-gram positive eubacteria-eukaryotes L-form-cell wall synthesis, antigenic properties-capsule-types, composition and function, cell membranes-structure-composition-properties.
- UNIT-2 Structure function of flagella- cilia- pili- gas vesicles-**Chromosomes, carboxysomes- magnetosomes and phycobolosomes- nucleoid- cell division- spores.
- UNIT-3 Reserve food materials- polyhydroxybutyrate- polyphosphate granules-**oil droplets-cyanophycin granules and sulphur inclusions.
- UNIT-4 Cultivation of bacteria- aerobic- anaerobic- shaker -still,** nutritional types, culture media used, growth curve, generation time-growth kinetics- asynchronous-synchronous-batch continuous culture, measurement of growth and factors affecting growth, control of bacterial physical and chemical agents-preservation methods.
- UNIT-5 Classification of micro organisms- introduction- Haeckel's three kingdom concept-** Whittaker's five kingdom concept three domain concept of Cari Woese, basis ennoicrobial classification and salient features of bacteria according to the Breges manual of determinative bacteriology cyanoacteria prochlorons and cyanelles.



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## PAPER- II BIOCHEMISTRY

- UNIT-1** **composition of living matter**, biochemistry of bacterial, animal and plant cell, specialized components of microorganisms and their structure and function
- UNIT-2** **Enzymes as biocatalysts**, enzyme classification specificity active site activity unit, isohyets, Enzyme kinetics, Michaelis-Mentoon equation for simple enzymes, determination of kinetic parameters, multistep reactions and rate limiting steps enzyme inhibition, allosterism, Kinetic analysis of allosteric enzymes, principles of allosteric regulation.
- UNIT-3** **Structural features and chemistry of macromolecules-** nucleic acid, proteins, carbohydrates and lipids and bio molecules such as antibiotics, pigments and other secondary metabolites.
- UNIT-4** **Bioenergetics and strategy of metabolism**; flow of energy through biosphere, strategy of energy production in the cell oxidation reduction, coupled reactions and group transfer, ATP production, structural features of bionmemembranes, transport, free energy and spontaneity of reaction,  $G$ ,  $G^\circ$  and equilibrium, basic concepts of acid, base pH and buffers.
- UNIT-5** **Cell metabolism**: catabolic principles and break down of carbohydrates, lipids, proteins and nucleic acids, biosynthesis of macromolecules, hormone regulation of metabolism vitamins and their role as coenzymes.



**PAPER- III  
MOLECULAR BIOLOGY**

- UNIT-1 Nucleic acids as genetic information carriers:** experimental evidence, DNA structure: historical aspects and current concepts, melting of DNA, DNA, DNA replication; general principle various properties of DNA polymerase, exonuclease activity in eukaryotic DNA polymerases, Superhelicity in DNA, linking number, topological properties, mechanisms of action of topoisomerases.
- UNIT-2 Initiation of replication of single stranded DNA.** Construction of replication fork in test tube Relationship between replication and their unique mode of DNA synthesis, Relationship between replication and cell cycle. Inhibitors of DNA replication (blocking precursor synthesis, nucleotide polymerization, altering DNA Structure), DNA damage and repair, types of DNA damage (Oxidative damage alkylation, pyrimiding dimers), Repair pathways-methyl-directed mismatch repair, very short patch repair nucleotide excision repair, base excision repair, recombination, repair, SOS system.
- UNIT-3 Structural features of RNA (tRNA, rRNA and mRNA) and relation to function.** Initiator and elongate class of tRNA, ribosome binding site on mRNA and corresponding site on rRNA, peptidyl transferase activity of 23S rRNA. Transcription: General principle, basic apparatus, types of RNA polymerases, steps: initiation, elongation and termination, inhibitors of RNA synthesis Polycistronic and monocistronic RNAs. Control of transcription by interaction between RNA polymerases and promoter regions, use of alternate sigma factors, controlled termination: attenuation and antitermination.
- UNIT-4 Regulation of gene expression: operon concept,** catabolite repression. Instability of bacterial RNA, positive and negative regulation, inducers and corepressors. Negative regulation E. coli operon; positive regulation- E. coli operon; regulation by attenuation-his and try operons; DNA binding proteins, enhancer sequences and control of transcription. Identification of protein binding sites of DNA, Global regulatory responses; heat & shock response, stringent response and regulation by small molecules such as PIP, GTP and cAMP, regulation of RNA and DNA synthesis.
- UNIT-5 Basic features of the genetic code. Protein synthesis:** steps details of initiation, elongation & termination role of various factors in the above steps inhibitors of protein synthesis signal hypothesis. In vitro transcription translation system



**PAPER- IV  
ENVIRONMENTAL MICROBIOLOGY**

- UNIT-1 Aerobiology-** Droplet nuclei, aerosol, assessment of air quality-solid liquid-impingent methods- Brief account of air borne transmission of microbes-viruses-bacteria & fungi, general account of air borne diseases and their preventive measures.
- UNIT-2 Aquatic microbiology-** Water ecosystems- types-water (ponds lakes streams) marine habitats (estuaries, mangroves, deep sea, hydrothermal vents, corarfeefs), zonation of water eco-systems-upwelling – eutrophication- food chain, Portability of water, microbial assessment of water quality-water purification brief account of major water borne diseases and their control measures.
- UNIT-3 Soil Microbiology-** Classification of soils- physical and chemical characteristics, micro flora of various soil types (Bacteria and nematodes in relevance to soil types, rhizosphere- phyllosphere- brief account of microbial interactions sysboisis- mutualism-commensalism- competition amensalism- synergism- parasitism- predation, biogeochemical cycles- carbon, nitrogen phosphorus and sulphur, bio fertilizers- biological nitrogen fixation- ( Rhizoid Frankie)- non symbiotic microbes Azotobacter- Azospirilu (vesicular carbuncular mycorrhizae- VAM) ecto endo, ectendomycorrhizae- remen microbiology.
- UNIT-4 Waste Treatment:** Wastes- types solid and liquid waste. Characterisation of solid liquid waste treatment-physical chemical; biological aerobic-anaerobic- primary- secondary- tertiary; solid waste treatment- saccharification - gasification- composting, Utilization of solid waste- food (SCP, mushroom, yeast): fuel ((ethanol, methane) fertilizer (composting)
- UNIT-5 Positive and negative roles of microbes in environment-** biodegradation of recalcitrant compounds – lignin - pesticides; bioaccumulation of metals and detoxification-bio pesticides; biodetroration- of paper- leather, wood textiles- metal corrosion- mode of deterioration-organisms involved-its disadvantages-mode of prevention, GMO and their impact.



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**PRACTICAL  
PAPER-I  
GENERAL MICROBIOLOGY**

**Microscopy-** Microscope and its operations components- Microscope adjustments- Light sources- microscopic measurements- coalition, Types of microscope available-theory, Observation of various types of microbes under phase contrast, dark field and fluorescence.

Preparation of glassware- washing-sterilization techniques-wet at-dry heat-fitter types-laminar flow chamber types-CDC-safety eels.

Preparation of culture media- nutritional needs of microbes-hydrated-selective-differential-autotrophic-etrotrophic. Culture chniques-adjustment of ph-buffers-pure culture techniques-prepare-of start sub culturing.

Microbial growth measurmemera cell count-turbidity measurement-percentage transmission. Optical Density- serial dilution-stoned plate count.

Morphological nutritional and cultural characteristic of bacteria densification of microbes, types of dyes-preparation-standing techniques-simple-Gram s-capsule-negative-flagella spore and nuclear.



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## PRACTICAL PAPER-II ANALYTICAL BIOCHEMISTRY

1. Measurement: criteria of reliability precision, accuracy, sensitivity, specificity.
2. Laboratory rules and safety regulation first aid.
3. Principles of colorimetric: verification of Beer's law, estimation of a selected protein, finding out  $I_{max}$ , relation between  $I$ ,  $D$  and percentage transmission, isolation and quantification of DNA from microorganism or other sources.
4. PH, PK. Henderson- Hasselbach equation, preparation of buffers.
5. Separation of amino acids by paper chromatography
6. Isolation of phospholipids from live and their separation by thin layer chromatography.
7. Separation of haemoglobin and blue dextrin by gel filtration.
8. Ion exchange chromatography: CM cellulose and DEAE cellulose.
9. Cell fractionation into nuclear, mitochondrial and cytoplasm fraction; estimation of marker enzymes.
10. Qualitative estimation of proteins, carbohydrates and liquids.



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## PRACTICAL PAPER-III MOLECULAR BIOLOGY

1. Single colony isolation and checking genetic markers.
2. Spontaneous and induced mutations-isolation of antibiotic resistant.
3. Preparation of aceto- carmine, aceto- orcein and fulgent stains.
4. Preparation of root tip squash of *Alium sativum*/*Allium capa*/*vicia fabo* and *Rhoeo* discolour.
5. Study of polygene chromosome in chironomous or *Drosophila* larvae.
6. Karyotypic study of plant and human chromosomes.
7. Use of chemical mutagens, isolation of mutants.

### Environmental Microbiology

1. isolation of bacteria from air and its biochemical activates.
2.
  - a. Bacterial analysis of water & waste water
  - b. Portability of water
  - c. Presumptive coli form test
3. Isolation of rhizobia from root nodules
4. Effect of heavy metal on the growth of then



**PAPER-I  
FUNDAMENTALS OF IMMUNOLOGY**

- UNIT-1 Immune system and Immunity-** History of immunology; structures, composition and functions of cells and organ's involved in immune system: host parasite relationship; microbial infection: virulence and host resistance; immune responses- innate Immunity, acquired Immunity, Immune haematology blood groups, blood transfusion and Rh incompatibilities.
- UNIT-2 Antigen and Antibodies Antigens-** structure and properties- types-Iso; and allo hap tens, adjuvants- antigen specificity vaccines and toxics. Immuno globulins-structure-heterogeneity- types and subtypes properties (physicochemical and Biological): Properties and functions of complement components; Complements pathway and biological consequences complements activation.
- UNIT-3 Antigen- Antibodies Reactions Invitro methods-** Agglutination, precipitation, complement fixation, immune fluorescence, ELISA radio Immunoassays; In vivo Methods: Skin tests and immune complex tissue demonstrations application of these methods in diagnosis of microbial diseases.
- UNIT -4 Major Histocompatibility Complex and Tumor Immunology.** Structure and functions of MHC and the HL-A system. Gene regulation and Ir-genes; HL-A and tissue transplantation-tissue typing methods for organ and tissue transplantation in humans; graft versus host reaction and rejection, autoimmunity, Theories, mechanism and diseases with their diagnosis, Tumors immunology tumorspecific antigens. Immune response to tumors, immunodiagnostic of tumors-detection of tumor mark real phofoetal proteins, carcionembryonic antigen etc.
- UNIT-5 Hypersensitivity Reaction- Antibody – mediated-**  
Type-I Anaphylaxis;  
Type-II Antibody dependent cell cytotoxicity.  
Type-III Immune complex mediated reactions;  
Type-IV Cell mediated hypersensitivity reactions. The respective disease.





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## PAPER-II MEDICAL MICROBIOLOGY

- UNIT-1** **Early discovery of pathogenic micro-organisms:** Development of bacteriology as scientific discipline contributions made by eminent scientists, Classification of medically important micro-organisms; Normal microbial flora of human body. Role of the resident flora, normal flora and the human host.
- UNIT-2** **Establishment, spreading, tissue damage and anti-** phagocytic factors, mechanism of bacterial adhesion colonization and invasion of mucos membranes of respiratory, enteric and urogenital tracts. Role of aggressins. Depolymerising enzymes organotropisms, variation and virulence.
- UNIT-3** **Classification of pathogenic bacteria.** Staphlococcus Streptococcus, Pneumococcus, Neisseria Corneacterium Bacillus, Clostridium Non sporting Anaerbbes, Organisms belonging to Entrobacteriaceas, Vibros, Non fermenting gram negative ballici Yessina; Heaemopphilus, Bordetella Brucella Mycobacteaia, Spirochaetes, anctiomycetes: Rickettsiae Chlamdiae.
- UNIT-4** General properties of Viruses Structure & geneal account on replocation Viruses host interactions structure and pathoiehicity of pox viruses Herpes virus, Adeno viruses. Picarno Viruses Orthomyxo Viruses: Paramyxo viruses, Arboviruses, Rhabdo viruses. Hepatities



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**PAPER-III**  
**MICROBIAL PHYSIOLOGY AND DEVELOPMENT**

- UNIT-1 Basic aspects of bioenergetics-** entropy-enthalpy-electron carriers artificial electron donor-inhibitors-uncouples-energy bond-phosphorylation.
- UNIT-2 Brief account of photosynthetic and accessory pigments-** chlorophyll bacteriochlorophyll II- rhodopsin- carotenoids phycobiliproteins, Carbohydrates-anabolism autotrophy- oxygenic-anoxygenic-photosynthesis- autotrophic generation of ATP, Fixation of  $\text{CO}_2$ - Calvin cycle- C3-C4 Pathway chemolithotrophy Sulphur-Iron-Hydrogen-Nitrogen Oxidation, Methanogenesis.
- UNIT-3 Respiratory metabolism-** Embden mayer Pfl pathway- Enters Doudroff pathway, glyoxalate pathway- krebs cycle-oxidative and substrate level phosphorylation reverses TCA cycle  
-gluconeogenesis Pasteur effect: fermentation of carbohydrates  
-homo and heterolactic fermentations.
- UNIT-4 Assimilation of nitrogen-** dinitrogen-nitrate nitrogen-ammonia synthesis of major amino acids-polyamines: Synthesis polysaccharides-peptidoglycan-biopolymers as cell component cell division endospore-structure-Properties-germination
- UNIT-5 Microbial development-** speciation and morphogenesis yeasts, yeast forms and their significance, Multi-cellular organization of selected microbes Dormancy.



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## PAPER- III MICROBIAL PHYSIOLOGY AND DEVELOPMENT

- Unit-1** **Biotechnological innovations in the chemical industry-** Biocatalyst in organic chemical synthesis, efficiency of growth and product information, growth stoichiometry. Maintenance energy requirement and maximum biomass, yield. P/O quotients metabolite overproduction and growth efficiency.
- Unit-2** Shake flask, stirred tank airlift fermenter, fed batch, continuous and immobilised, cell reactor, Large scale production.
- Unit-3** Metabolic pathways and metabolic control mechanism, industrial production of citric acid, enzymes, ethanol, acetic acid, production of antibodies, Steroids.
- Unit-4** Bio-fertilizers, bio-pesticides, mushroom production, fermented food beverages, Biopolymers, Bioremediation.
- Unit-5** Industrial stains, Strategies for selection and improvement maintenance containment of recombinant organisms, large scale production using recombinant micro-organisms, Product recovery.