ACADEMIC (1-BOARD OF STUDIES) SECTION

Phone: (02462) 229542  E-mail: bos.srtmun@gmail.com
Fax    : (02462) 229574  Website: www.srtmun.ac.in

CBCS Pattern

1. Botany
2. Certificate Course in Industrial Safety, Health and Environmental Management (SHM)
3. Chemistry
4. Computer Application
5. Computer Network
6. Computer Science
7. Geophysics
8. Mathematics
9. M.C.A.
10. Microbiology
11. Physics
12. Zoology

या परिपक्वात्मक संकल्पातील विषाणु व तंत्रज्ञान विभागातील पदव्युत्रस्तर स्तरावर होणारे CBCS Pattern नुसारे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्यावरून.

1. बॉटनी
2. इंस्टीटशनल सेफ्टी, हेल्थ एण्ड एनवियरमेंट मॅॅनेजमेंट (SHM) डिप्लोमा
3. राइजनल एनियमेंट
4. कंप्यूटर ऐप्लिकेशन
5. कंप्यूटर नेटवर्क
6. कंप्यूटर साइंस
7. जीफाइजिस
8. मॅथेमेटिक्स
9. मी.सी.ए.
10. माइक्रोबायोलॉजी
11. फिजिक्स
12. जॉलोजी

या परिपक्वात्मक संकल्पातील विषाणु व तंत्रज्ञान तथा मान्यता प्राप्त विभागातील पदव्युत्रस्तर स्तरावर होणारे CBCS Pattern नुसारे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्यात येईल.

1. बॉटनी
2. इंस्टीटशनल सेफ्टी, हेल्थ एण्ड एनवियरमेंट मॅॅनेजमेंट (SHM) डिप्लोमा
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8. मॅथेमेटिक्स
9. मी.सी.ए.
10. माइक्रोबायोलॉजी
11. फिजिक्स
12. जॉलोजी
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|             |             |                                                   |                               | 100            | 1250  | 1250 2500 |
There will be four papers of practicals in first year and three papers of practicals and one dissertation/review writing/Lab course program in Applied Microbiology in second year. Each practical course and dissertation will be of 100 marks (04 credits).

Laboratory Course: First Year (1st & 2nd Semester)

- Total Credits / year = 50
- Total Credits of All Four Semesters = 100
- Total Marks of All Four Semesters = 2500
- CIA Two test of 15 marks each will be conducted 10 marks for home assignment/tutorial and 10 for seminar/conference presentation/ The examinations for laboratory Courses (External) will be held at the end of 2nd & 4th Semesters.
List of Discipline Specific Electives:

Elective-I (02 credit course)

1. Biostatistics
2. Bioinstrumentation
3. Mycology
4. Protozoalogy

Elective-II (02 credit course)

1. Enzymology
2. Molecular Biology
3. Proteomics
4. Genomics
5. Apiculture
6. Sericulture

Note: Students should opt any two electives from above list for each semester or equivalent course of similar title and same weightage /credits from NPTL, SWYAM or MOOCK
Details of Open Elective papers offered under CBCS at PG level:

Department of Microbiology:

<table>
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<tr>
<th>Sr. No.</th>
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<th>Semester for which course is offered</th>
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<td>Microbiological Analysis</td>
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<td>Any graduate</td>
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<td>04</td>
<td>Infectious Diseases</td>
<td>04 credits</td>
<td>IV semester</td>
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<td>05</td>
<td>Medical Microbiology</td>
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<td>06</td>
<td>Pharmaceutical Microbiology</td>
<td>04 credits</td>
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<td>Any Science graduate</td>
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MBT-101  Virology

Objectives:

Primary objectives of this course are to facilitate conceptual understanding of
Classification and cultivation of viruses Learning outcome
At the completion of course student will able to illustrate morphology and replication strategy of viruses

UNIT- I

Brief outline on discovery and origin of viruses. Classification and general properties of major families of viruses  morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses. Viral genome; their types and structure, viral related agents- viroids and prions.

UNIT-II

Cultivation of inhibition, neutralization test, complement fixation, ELISA, RIA. Purification of viruses: gradient centrifuge, electrophoresis, and chromatography viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture. 2. Assay of viruses: physical and chemical methods, end point method. Serological methods

UNIT-III

Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV. 2. Transmission o plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell. 3. Animal viruses: nomenclature and classification of animal viruses. 4. General idea about Cyanophage, and Mycophage.

Unit-IV


Reference Books:

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
MBT 102 MICROBIAL PHYSIOLOGY

Objectives:

- To develop a sufficient background to students about the growth of Microbes.
- To acquire knowledge on basic aspects of bacterial respiration and photosynthesis.
- To acquire knowledge on microbial stress response.

Outcomes

- Knowledge on growth of Microbes
- General Information about microbial respiration and photosynthesis
- Clear idea on physiological adaptations under stress conditions.

Unit-I

Structure and functions of prokaryotes, Appendages, Glycocalyx, cell wall, Periplasm, Cell membrane and cytoplasm. Microbial Nutrition- Nutritional requirement for growth (macronutrients, micronutrients and growth factors), nutritional types of microorganism.

Unit –II:


Unit III

Oxidation reduction potential, components of electron transport chain free Oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain, Coupling sites, Q loops, Q cycles and proton pumps, patterns of electron flow in aerobic and anaerobic bacteria, ATP synthesis in heterotrophic and phototrophic bacteria. Phototrophic prokaryotes, photosynthetic pigments, reactions of photosynthetic apparatus, photosynthetic apparatus of cyanobacteria, photosynthesis in halobacteria

Unit-IV

Introduction to two component system, regulatory systems during aerobic, anaerobic shifts: Arc, Enr, Nar, Fhl A regulon, response to phosphate supply: The pho regulon, Quorum sensing : A to C signalling system, sporulation in Bacillus subtilis, control of competence in Bacillus subtilis. Response to environmental stress and homeostasis: Heat shock responses, response to osmotic stress, PH homeostasis and osmotic homeostasis.

References:
MBT-103 Immunology

- **Primary objectives of this course are to facilitate conceptual understanding of**
- Components and functions of Immune system, Development of Immune response interdependence of HI and CMI, Disorders of Immune system
- Learning outcome
  - At the completion of course student will able to illustrate
  - Anatomy and function of cells and organs of immune system, Antigen, Antibody and their interactions.
  - Autoimmunity, Hypersensitivity

UNIT-I


UNIT-II


UNIT-III


UNIT-IV

Cancer immunology: tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine. Hybridoma technology:

Reference Books:

Elective-I  Bio-statistics

Objectives

- To learn how to effectively collect data, describe and use data to make inferences
- Demonstrate understanding of hypothesis testing and Choose and apply appropriate statistical methods for analyzing variables.

Outcomes

- General Information about collection and analysis of data.
- Knowledge on use of statistical method in analysis and interpretation of biological data.

UNIT–I

Introduction to biostatistics, collection of data, sampling methods, processing and presentation of data. Measures of central tendency and dispersion (mean, median, mode, range, standard deviation, mean deviation, variance)

UNIT–II

Correlation, calculation of Karl Pearson’s coefficient of correlation, Regression Analysis, linear regression, regression equation, Hypothesis testing: Types of hypothesis testing: t-test, $\chi^2$-test, and F-test., ANOVA. Software used in biostatistics- SPSS.

References:

4. Biostatistics - 7th Edition by Daniel
6. Fundamental of Biostatistics by Khan
8. Biostatistical Methods by Lachin
Elective-I  Bio-instrumentation

Objectives
- To learn the principle, working and applications of basic bio-molecular techniques
- To acquire knowledge on advanced instrumentation techniques.

Outcomes
- General Information about basic bio-molecular techniques
- Knowledge on advanced instrumentation techniques.

Unit I- Basic techniques

Chromatography & Centrifugation: Principle, Working & Applications of chromatography (paper, thin layer, gel filtration, ion exchange, affinity, gas chromatography, HPLC, HPTLC) and centrifugation (preparative, analytical, ultracentrifugation, differential and density gradient methods). Electrophoretic Techniques: Basic principles, working and applications of paper, agarose gel electrophoresis, native and denaturing PAGE and two dimensional electrophoresis.

Unit II – Spectroscopy and radio isotopic techniques:

Principle, working and applications of UV, visible, IR, NMR, Fluorescence, Atomic Absorption, Mass and Raman Spectroscopy. Use of radioisotopes in biological sciences, principle and application of tracer techniques, Geiger- Muller and Scintillation counters, autoradiography and its applications

REFERENCES:

Elective-I Mycology

Primary objectives of this course are to facilitate conceptual understanding of fungal pathogens, applications of fungi.

Learning outcome
At the completion of course student will able to illustrate diagnosis, spread, prevention and treatment for fungal pathogens, application of fungi.

Unit I

Medical Mycology, Introduction to fungi, Plant fungal pathogens and human fungal pathogens diagnosis, spread, prevention and treatment Tinea pedis or athlete's foot, Candida albicans. Infection, Ring worm, Aspergillosis

Unit II

Applied Mycology: Role of fungi in biotechnology, Application of fungi in food industry. (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides);

References

Introductory Mycology, 4ed Paperback – 2007 by C.J. Alexopoulos (Author), C.W. Mims (Author), M. Blackwell (Author)

Textbook of Medical Mycology Hardcover – 2018 by Jagdish Chander (Author)
Elective-I Protozoalogy

Objectives:

This course is designed to teach students-
1. The basic concept of systematic protozoalogy
2. To study systematic of subkingdom protozoa
3. To study biological importance of free living protozoa
4. To study methodology of collection and identification of free living protozoa
5. To study culture methods of free living protozoa

Unit I:

1. Classification of protozoa upto order level
2. Factors affecting growth of protozoa: Balanced growth and non-balanced growth
3. Ecology of free living protozoa
   i) Marine protozoa
   ii) Planktonic protozoa
   iii) Soil protozoa
   iv) Protozoan blooms
   v)

Unit II:

1. Nutrition in protozoa
   i) Methods of feeding: Filter feeding, Raptorial feeding, diffusion feeding
   ii) Digestion
   iii) Nutritional requirements

References:

1. Aikawa and Sterling- Intracellular Parasitic Protozoa
2. Baker- Parasitic Protozoa
3. Chandler and Read- An introduction to Parasitology
4. Chattergy- Parasitology
5. Thomas C Cheng- General Parasitology
6. Hall- Protozoalogy
7. Kudo-Protozoalogy
8. Tayler and Baker- Cultivation of Parasites in vitro
Primary objectives of this course are to facilitate conceptual understanding of extremophiles and their types, Adaptive strategies in typical extremophiles, systematic and occurrence of Archaea, Mycorrhiza

Learning outcome
At the completion of course student will able to illustrate Extreme habitats, Applications of extremophiles, culture dependent and independent methods of identification, Application of mycorrhiza

Unit-I

Microbial life at extreme temperature: prokaryotes and eukaryotes, habitats and ecological aspects, mechanism and molecular basis of thermophily and psychrophily commercial aspects of thermophiles and psychrophiles, application of thermozymes.

Microbial life at extreme pH: Classification, habitats, soda lakes and deserts, calcium alkalophily, acidotol tolerance, mechanism of adaptation (external and internal PH, cell surface and membrane), applications.

Unit-II

Halophily and Oligotrophy: Classification, dead sea, cell wall and membrane, purple membrane, compatible solutes, osmoadaptation/halotolerance. Applications of halophiles, mechanism and regulation of oligotrophy. Life under high irradiation: Ionizing and non ionizing radiation, radiation sensitivity and nature of damage, mechanism of protection in radiation resistant strains.

Unit-III

Archaea: Systematics and occurrence, diversity, characteristic features, significance and potential applications (e.g. biochips, methane generation, ultra filtration membranes, production of PHB and PHA, desulfurization of coal and crude oil, bioleaching of metals, enzymes and compatible solutes) of different groups of archaebacteria (Crenarchaeota, Euarchaeota, Korarcheota and Nanoarchaeota.)

Bacteria: Conventional and molecular systematic, occurance, diversity, characteristic features, significance and applications of various bacterial groups according to Bergey’s Manual of Systematic Bacteriology.

Unit-IV

Fungal systematic and diversity: Implications of molecular and biochemical methods including r-DNA analysis, RFLP, RAPD and other fingerprinting techniques, fatty acids, polysaccharides and lipids, role of secondary metabolites insystematics, endophytic fungi and their adaptations, endophytes as biocontrol agents. Mycorrhizal fungi: Diversity of endo and ecto mycorrhizal fungi, biology of arbuscular mycorrhizal fungi, signalling, penetration and colonization inside roots, application and recent developments in the field of mycorrhiza. Algal diversity: Importance of algae in production of algal pigments, biofuels, hydrogen production, important bioactive molecules, role of algae in sustainable environment.

References:

2. Recent Advances on Mycorrhizal Fungi (Fungal Biology) by Marcela C. Pagano (Editor)
MBT-202: Microbial Metabolism

Objectives
- To learn the characteristics of enzymes
- To acquire knowledge on metabolism of bio-molecules.

Outcomes
- General Information about enzymes
- Knowledge on metabolism of bio-molecules

Unit-I
1. General characteristics of enzymes, activation energy, coupled reactions, active site and its importance, forms and derivation of M.M Equation, Significance of Vmax and Km, types of enzyme inhibition.

2. Regulation of enzyme synthesis: Induction, catabolite repression, end product repression and attenuation, Allosteric enzymes and allosteric control, covalent modification of enzymes Nitrogen fixing organisms, biochemistry of nitrogen fixation, regulation of nitrogenase.

Unit-II
1. Growth of E. coli on glucose and substrates other than glucose, PPP, ED pathway, citric acid cycle- Reversed TCA cycle, anapleurtotic reactions, glyoxylate cycle, Calvin cycle.

2. Assimilation of nitrate and sulfate, Dissimilation of nitrate and sulfate, ammonia oxidizing bacteria, nitrite oxidizing bacteria, sulfur and iron oxidizing bacteria, Metabolism of hydrocarbons and lipids.

Unit-III
1. Biosynthesis of amino acids- oxaloacetate and pyruvate family, phosphoglycerate family, α-oxoglutarate family and aromatic amino acids.

2. Biosynthesis of fatty acids, phosphatidic acids, phospholipids and macromolecules (Glycogen, cell wall, outer membrane layer, Levan and dextran synthesis), Biosynthesis of purines and pyrimidines.

Unit- IV
1. Alcohol fermentation, Lactate fermentation, Butyrate and acetone –butanol fermentation, Propionate and succinate fermentation.

2. Methane fermentation, Sulfide fermentation, Anaerobic food chain, Fermentation of single amino acids, Stickland reaction and heterocyclic compounds.

References:
3. Biochemistry by A. L. Lehninger,
MBT-203: MBT – 203 Microbial Genetics

Course objectives: objectives of this paper are to take students through basics of microbial genome organization, mutation, DNA repair, recombination and regulation. On covering all these concepts students will be exposed to concept of microbial genetics, genome organization in microorganisms, recombination and gene transfer mechanism and regulation.

Students learning outcomes: on successful completion of this course students will be able;

- Describe fundamental principles of microbial genetics.
- Understand mechanism of DNA damage, mutation and repair.
- Describe mechanism of gene transfer between and within the bacterial cells.
- Understand how gene expression is regulated.

Unit – I.

Brief historical evidences of genetic material in bacteria and viruses, features of genome organizations in viruses, prokaryotes, archea and eukaryotes. plasmids; bacteria and yeast. concept of operon, interrupted genes, gene families, structure of chromatin and chromosome. unique and repetitive DNA, heterochromatin, euromatin, Allele, transposons.

Unit – II.

DNA Damage and Repair.

Mutation; spontaneous and induced, molecular mechanism of mutation, mutation rate, mutation priority, effect of mutation on gene product, significance of mutants, reversion of mutation, intragenic and intergenic mutation, suppressor mutation and complementation.

DNA protection and Repair: Role of restriction modification system in DNA protection and repair.

Unit – III.

Recombination and methods of gene transfer in bacteria; Homologous recombination, site-specific recombination, illegitimate recombination.

Conjugation: F-plasmid; structure and function, origin of conjugation, Hfr and F strain, interrupted and un-interrupted mating, time map and recombination, conjugation in E. coli, F-factor and their use in genetic mapping.

Transformation: Natural and artificial, competence, transformation in Bacillus, Himophilus and Streptococcus, mechanism of recombination, genetic mapping.
Transduction: Generalized and specialized transduction, λ-phage and P1-phage, HFT and LFT lysate, cotransduction and transduction mapping.

Transposons: Discovery of transposition, classes of bacterial transposons, analysis of transposition, transposon mutagenesis and Mu-transposon.

Unit – IV:

Gene regulation: control of gene expression, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, positive regulation in E. coli (arabinose operon) and negative regulation in E. coli (lac operon), inducers and repressors, trp operon- regulation by attenuation, gal, tol operon and regulons with recent advances.

References:

1. Fundamental Bacterial Genetics by Nancy Trun and Jenanine Trumphy (2003), Publisher: Blackwell Publishers.
7. Gene XII by Lewin Oxford University press. 2017
9. Recombinant DNA by Watson J.D.
Elective-II (A): Enzymology

Objectives
- To learn the enzyme modification and recent developments in enzymes
- To acquire knowledge on applicability of enzymes.

Outcomes
- General Information about enzyme modifications.
- Knowledge on applications of enzymes

Unit I
1. **Enzyme engineering**: Introduction to enzyme engineering and their application, genetic and chemical modification, methods of enzyme immobilization, homology modeling, biosensors, enzyme sensors for clinical processes and environmental analysis, abzymes, ribozymes, synzymes and recent developments, enzyme carriers, enzyme probe.

2. **Enzymes in genetic recombination**: Restriction endonucleases, SI nucleases, BAL 31 nucleases, DNA ligase, DNA polymerase, polynucleotide kinases, phosphatases and reverse transcriptase

Unit II
1. **Enzymes in medical diagnosis and therapy**: Lactate dehydrogenase, malate dehydrogenase, Fructose 6 biphosphatase, acid and alkaline phosphatase, Glucose 6 phosphate dehydrogenase, Enzyme in cancer therapy, genetic diseases, clotting disorders, Neonatal jaundice, surgery, toxicity.

2. **Industrial applications of enzymes**: catalysts in the manufacturing and other conversion processes as analytical tools (enzyme electrode).

References:
6. *Enzymology by palmer*
11. *Topics in enzymes and fermentation biotechnology* by L.N.Weiseman, John wiley and Sons.
Lab Course I

A Agglutination test:-
1 Widal test ,
2 VDRL/RPR TEST ,
3 RA TEST ,
4 Detection of blood group antigens
B Precipitation
5 Radial immunodiffusion ,
6 Ouchleroney assay.
7 ELISA TEST: - online assay and quiz.
8 DLC (differential leucocyte count)
9 Isolation and enumeration of bacteriophage.
10 Growth phase of phage and burst size.
11 Turbidometric assay
12 Study of plant viruses
13 Collection of infected plant material
14 Study of morphology of lesions on infected plant
1. Preparation of microbiological media: autotrophic media, minimal media, basic media, enrichment media, enriched media and differential media.
2. Culturing techniques of microbes: Slant and stab, tube culture, flask culture and shake flask culture.
3. Anaerobic jar and its uses.
4. Studies on bacterial growth curve
5. Effect of pH, temperature, salt concentration on bacterial growth.
6. Microbial growth experiments: viable count of culture and generation time determination
7. Glucose uptake by *E. coli* or *Saccharomyces cerevisiae*
8. Isolation of photosynthetic bacteria.
9. Estimation of calcium ion in sporulating bacteria (AAS/ Colorimeter/ EDTA)
11. Studies on pH titration curves of amino acids/acetic acid and determination of pKa values and Handerson-Hasselbach equation.
13. Thin layer chromatography - separation of amino acid.
14. Spectrophotometric estimation of biomolecules (carbohydrates, proteins, lipids and nucleic acids)
15. Absorption maxima of proteins, nucleic acid, aromatic amino acid, riboflavin and photosynthetic pigments.
16. Representation of Statistical data by
   a) Histograms  b) Ogive Curves  c) Pie diagrams
17. Determination of Statistical averages/ central tendencies.
   a) Arithmetic mean  b) Median  c) Mode
18. Determination of measures of Dispersion
   a) Mean deviation  b) Standard deviation and coefficient of variation
   c) Quartile deviation
19. Tests of Significance-Application of following
   a) Chi- Square test  b) t- test  c) Standard error
Lab course III:

1. Studies on halophiles from sea water (pigmentation and salt tolerance).
2. Studies on alkalophiles isolated from lonar water (at least one enzyme).
3. Isolation of acidophiles from metal sulphides or acid mine water.
4. Demonstration of iron oxidation rate of Thiobacillus thiooxidans isolated
5. Physico chemical analysis of water sample pH, DO, phosphate, BOD, and COD.
8. Enrichment and isolation of thermophiles from hot water spring (at least one enzyme).
9. Isolation of fungal endophytes.
10. Studies on biocontrol activities of endophytes.
11. Isolation and identification of cyanobacteria.
12. Isolation and purification of degradative plasmid of microbes growing in polluted environments.
14. Recovery of toxic metal ions an industrial effluent by immobilized cells.
Lab Course IV:

1) Isolation and identification of Reserve food material (Glycogen / Polyphosphate/ PHB) of
*B.megaterium* and Azotobacter sp.

2) Demonstration of endogenous metabolism in *B. megaterium* or *E.coli* and their survival under
saturation condition.

3) Quantitative estimation of amino acid by Rosen’s method.

4) Quantitative estimation of sugar by Sumners method.

5) Quantitative estimation of protein by Folin Lowry /Biuret method.

6) Preparation and analysis of polar lipids from *S. aureus* and *E.coli*.

7) Isolation of autotrophs.

8) Isolation of hydrocarbon degraders

9) Isolation and characterization of nitrogen fixers.

10) Isolation and characterization of chemolithotrophic microorganisms.

11) Isolation of cellulose, pectin, xylan and chitin degraders and estimation of their activities.

12) Nitrification and denitrification by soil isolates

13) Qualitative study of photosynthesis in photosynthetic bacteria and Cynobacteria.

14) Isolation of iron and sulfur oxidizing bacteria.

15) Effect of UV, gamma radiations pH, disinfectants, chemicals and heavy metal ions on
spore germination of *Bacillus SP*.

16) Determination of Iron Oxidation Rate of *Thiobacillus ferrooxidans*.

17) Determination of Sulfur Oxidation Rate of *Thiobacillus thiooxidans*.

18) Microbial degradation, decolorization and adsorption of organic dyes

19) Detection of enzyme activity of lipase, Urease, invertase, protease, Tween 80 hydrolysis.

20) Determination of kinetic constant of amylase:-Amylase activity, Vmax.Km.

21) Effect of pH and temperature on amylase activity.

22) Effect of inhibitors on amylase activity.

23) An Enzyme Purification theme
   (a) Preparation of cell-free lysates & Ammonium Sulfate precipitation
   (b) Enzyme Kinetic Parameters: Km, Vmax and Kcat.
   (c) Column Chromatography/ Ion-exchange Chromatography/ Gel Filtration/ Affinity
       Chromatography/ Generating a purification Table
   (d) Assessing purity by SDS-PAGE Gel Electrophoresis.

24) Determination of Molecular weight of Protein by Column chromatography

25) Determination of Surface Tension by Stalagmometer.