

SYLLABUS (CBCS) M.Sc.MICROBIOLOGY

SARGUJA UNIVERSITY, AMBIKAPUR, C.G.

WITH EFFECT FROM ACADEMIC YEAR : 2018 -19

M. Sc. in MICROBIOLOGY:

FACULTY OF LIFE SCIENCE

FIRST SEMESTER (ODD SEMESTER)

Eligibility Criteria (Qualifying Exams)	Admission Criteria	Course Code	Course Type	COURSE (PAPER/SUBJECTS)	Credits	Maximum Marks		
						CCA	ESE	Total
Bachelor Degree in BIOLOGY/MICROBIOLOGY/ BIOTECHNOLOGY/BIOCHEMISTRY, or B.Sc. (Ag.) or B.E. BIOTECHNOLOGY or M.B.B.S	Merit List/Entrance Test (written or/and oral) if decided by the University Observance of Reservation Policy.	MMB 101	CCC	General Microbiology	6	30	70	100
		MMB 102	CCC	Microbial Biochemistry	6	30	70	100
		MMB 103	CCC	Molecular Biology	6	30	70	100
		MMB S01	OSC	Computer Application Bioinstrumentation and Biostatistics	6	30	70	100
		MMBA01	ECC/CB	Cell Biology and Genetics	6	30	70	100
		MMBA02	ECC/CB	Enzyme and Enzyme Technology				
		MMBA03	ECC/CB	Science and Technology for Rural Development				
		MMB111	LAB	Lab Course-1	4	-	-	100
		Minimum credits in complete semester would be 30					Total: 34	

The M.Sc. program will be divided into four semesters each being of six months duration. Each semester comprises of compulsory core courses (CCC) and elective core courses (ECC). Lab course (LC) will be based on CCC. Each theoretical course will be divided into Internal Assessment of 30 marks and semester end examination of 70 marks.

Duration of Theoretical and Practical Examination Time: 03 Hours

M.Sc. MICROBIOLOGY		I SEMESTER
COURSE CODE: MMB 101		COURSE TYPE: CCC
COURSE TITLE: GENERAL MICROBIOLOGY		
CREDIT: 06	TEACHING HOURS: 90	
MARKS: 100	THEORY EXAM. : 70 CCA: 30	
OBJECTIVE: This course covers the major aspects of microbiology to impart the students' knowledge of the microbial world (bacteria, fungi, algae, viruses) and to make them efficient in handling microbes in lab and utilize commercially important microbes in industrial processes.		
UNIT-1 18 Hours	History and Scope of Microbiology. Sterilization Methods; Physical and Chemical. Nutritional Requirement of Microorganisms. Mode of Microbial Nutrition. Microbial Growth, Measurement and Factor Affecting Growth. Growth curve. Culture media; Selective, Differential and Enrichment media. Pure Culture Techniques.	
UNIT-2 18 Hours	Structure and Characteristic features of Bacteria. Bacterial Classification. Major Characteristics used in Microbial Taxonomy. Bergey's manual. Current methods of microbial taxonomy, including ribotyping; Ribosomal RNA sequencing.	
UNIT-3 18 Hours	Structure and characteristic features of Algae and Protozoa. General microscopic and macroscopic structures and characters of Fungi. Fungal Classification, Characteristics of fungal division. Importance of Fungi. Fungi as pathogen to man, animals and plants.	
UNIT-4 16 Hours	Microbial Genetics: transformation, transduction, and conjugation. Plasmids and Transposons. Discovery, classification and structure of viruses. Viral replication with examples of Retroviruses. Bacteriophages discovery and structure. Lytic and Lysogenic Cycles.	
UNIT-5 20 Hours	Special groups of bacteria: general characteristics, structure and importance of Cyanobacteria, Mycoplasma, Actinomycetes, Rickettsia and Chlamydae.	

- *Adams, Martin, R. Moss., Maurice O. (2004) Food Microbiology, Third edition, Royal Society of Chemistry, Cambridge*
- *Balasubramanian, D. and Bryce, C.F.A. Jeyaraman, K. Dharmalingam K. Green (2004) Concepts in Biotechnology, COSTED-IBN, University Press, Hyderabad*
- *Gerard. J. Tortora, Berdell R. Funke, Christian L. Case, (2006), Microbiology: An introduction, ninth edition, Benjamin Cummings Publications*
- *Pelzer M.J. Jr., Chan. E.C.S. and Kreig N.R. (1993), Microbiology, McGraw Hill Inc. New York*
- *Ronald M. Atlas, Richard Bartha R., (2004), Microbial Ecology – Fundamentals and applications, Pearson education Limited*
- *Salle A.J. (1999), Fundamental Principles of Bacteriology, fifth edition, Tata McGraw – Hill Publishing Company Limited, New York.*
- *Stanbury P.F. & Whitaker. A. and S.J. Hall (2003), Principles of Fermentation Technology, Butterworth – Heineman, New Delhi*
- *Cappuccino, Sherman (2005) Microbiology: A Laboratory Manual, 7th Edition, Pearson Education.*

M.Sc. MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB 102		COURSE TYPE: CCC	
COURSE TITLE: MICROBIAL BIOCHEMISTRY			
CREDIT: 06		THEORY HOURS: 90	
MARKS: 100		THEORY EXAM. : 70	CCA: 30
<p>OBJECTIVE: The main objective of this course is to fulfill the basic requirement of the knowledge regarding Biochemical and Biomolecular avenue. The contents of the course cover the structure and Physio-chemical properties of various Biomolecules and their function in the living world.</p>			
UNIT-1 20 Hours	Properties of water, Dissociation of water and its ion product K_w , Colligative properties, Osmosis, pH, Bronsted acids, ionization of weak acids and bases; Buffers and buffering capacity; Titration curves and buffering action, Henderson Hasselbalch equation; Law of thermodynamics, Gibb's free energy,		
UNIT-2 20 Hours	Amino acids: structure, properties & classification; naturally occurring modifications of amino acids, non-protein amino acids. Structure of proteins: primary, secondary, tertiary and quaternary structures; Ramachandran plots; Structure and Function of Fibrous and Globular proteins, Lipoprotein, Metalloproteins & Nucleoproteins.		
UNIT-3 15 Hours	Carbohydrates: Classification, functions, Monosaccharide, hemiketal and hemiacetal formation, furanoses, pyranoses, anomers, epimers; Disaccharides-sucrose, lactose, maltose; Polysaccharide (homo and hetero), Peptidoglycans, Glycoproteins, Proteoglycans		
UNIT-4 20 Hours	Lipids: Detailed classification, structure, properties and Biological functions. Glycerides, Phospholipids, Sphingolipids & Glycolipids; Vitamins & Hormones – Classification, structure & physiological functions.		
UNIT-5 15 Hours	Enzymes: Classification, properties and functions, Mechanisms of enzyme action, Enzyme Kinetics, Enzyme Inhibition. Enzyme purification. Regulatory enzymes, Isoenzymes, Ribozymes.		

- *Arthur M. Lest, (2002), Introduction to Protein Architecture, The Structural Biology of Proteins, Oxford University Press*
- *Geofrey L. Zubay, William W. Passon, Dennis L. Vance, (1988), Principles of Biochemistry, IV edition, W. M. C. Brown Publishers, Australia*
- *Gregory A. Petsko, Dagmar Ringe, (2003) Protein structure and function (Printers in Biology) Siauer Associates*
- *Michael Cox., David. L. Nelson, (2004) Lehninger, Principles of Biochemistry,*
- *Murray, R.K. A. Grannor, D.K. Mayes, P.A. and Rodwell V. W. (2000) Harper's Biochemistry, McGraw Hill Pvt. Ltd., New Delhi*
- *Nicholes C. Price and Lewis Stevens, (2001), Fundamentals of Enzymology, The cell and molecular Biology of catalytic proteins, Oxford University Press.*
- *Sober, (2002), Handbook of Biochemistry selected Data for Molecular Biology, II.Edition*
- *Stryer.L. (2003) Biochemistry, V. Edition. W.H. Freeman & Co. NY Kalyani Publishers, New Delhi.*

M.Sc. IN MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB 103		COURSE TYPE: CCC	
COURSE TITLE: MOLECULAR BIOLOGY			
MARKS: 100			
CREDIT: 6		THEORY: 70 CCA: 30	
UNIT-1	<p>The nature of Genetic material: The structure of DNA, Types of DNA ; Melting of DNA, C -value, Superhelicity, Organization of Microbial Genomes, Organization of Eukaryotic Genomes, Chromatin arrangement, nucleosome formation.</p>		
UNIT-2	<p>DNA Replication: General features, Mechanism of Replication. Enzymology including Polymerase, Topoisomerase, Primase and Ligase. Rolling circle model and replication at telomeres. DNA Repair: Types of DNA damage & Mechanism of DNA Repair. Mutation: Types, Molecular basis of mutation. Homologous recombination of genes: Holiday junction – Rec. A and recombination, site specific recombination.</p>		
UNIT-3	<p>Transcription: Transcription machinery of prokaryotes, various transcription enzymes and cofactors, Recognition sequences initiation, elongation and termination, sigma factors, Sigma factor cycle, RNA polymerase. Post-transcriptional processes: RNA processing, splicing, capping and polyadenylation, r-RNA and t-RNA processing, RNA Editing.</p>		
UNIT-4	<p>Translation: The genetic code, Mechanisms of translation in prokaryotes, ribosomes, and initiation, elongation and termination, Regulation of translation, inhibitors of translation, stringent response in bacteria, Post-translational processes: Protein modification, folding, chaperones, The Signal Hypothesis.</p>		

Regulation of gene expression: Operon concept, transcription control in prokaryotes – positive & negative control, Various conserved consensus sequences. lac-operon, trp-Operon and arabinose Operon, catabolic control, attenuation control. Transcriptional & Post translational control.

1. *Watson, J.D. (1987) – Molecular Biology of Gene – The Benjamin / Cummings Publishing Company Inc., California*
2. *Lodishetal (2000) – Molecular Cell Biology, Fourth Edition, W.H. Freeman and Company, New York.*
3. *Stanley. R. Maloy. John.E. Cronan., David Freifelder (1998), Microbial Genetics, II edition, Narosa Publishing House, Madras*
4. *Strickberger (1996), Genetics, Prentice Hall of InidaPvt. Ltd., New Delhi*
5. *Brown. T.A. (2006), Genomes 3, Garland Science Publications*
6. *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff. Keith Roberts, Peter Walter, (2002), Molecular Biology of the Cell, IV edition, Garland Publishing, New York*
7. *Anthony J.F. Griffiths, (2000), An introduction to Genetic Analysis, W.H. Freeman*
8. *Paul. G. Young. (2003), Exploring Genomics, W.H. Freeman*
9. *Geoffrey M. Cooper, Robert E. Hausman, (2007). The Cell – A Molecular Approach, Sinauer Associates, Inc.,*

M.Sc. MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB S01		COURSE TYPE: OSC	
COURSE TITLE: COMPUTER APPLICATION BIOINSTRUMENTATION AND BIOSTATISTICS			
CREDIT: 06		TEACHING HOURS: 90	
MARKS: 100		THEORY EXAM. : 70	CCA: 30
<p>Objective: Statistical analysis has become a major requisite for the authenticity of research undertaken and also for the verification of research findings. In a similar way instruments are the backbone of biotechnological research. In this regards, this paper has been designed to bridge the gap between the theoretical and practical aspects of the subject.</p>			
UNIT-1 15 Hours	<p>Basic knowledge of computers, hardware and software. Word Processing - MS Word : Creating, Saving, Opening, Editing, Formatting, Page Setup Spreadsheet - MS Excel: Opening a Blank or New Workbook, entering data/Function/ Formula into worksheet cell, Saving, Editing, Formatting, Page Setup and printing Workbooks. PageMaker, Paint and Adobe Photoshop.</p>		
UNIT-2 15 Hours	<p>Presentation Software - MS Power Point: Creating and enhancing a presentation, modifying a presentation, working with visual elements, adding Animations & Transitions and delivering a presentation. Introduction to internet and its applications, electronic and teleconferencing. Introduction and application of different computer software in handling the statistical problems and Data-management.</p>		
UNIT-3 20 Hours	<p>Principals, types and applications of Microscope including SEM TEM, pH meter, Electrophoresis, Spectrophotometer, Centrifugation, Chromatography; Paper, Gas, Ion exchange, Thin layer and HPLC.</p>		
UNIT-4 20 Hours	<p>Introduction to Biostatistics, concept of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data. Measures of Central Tendency: Mean, Median, Mode. Concept of Probability, and their applications.</p>		
UNIT-5 20 Hours	<p>Measures of Variability: Range, Standard Deviation. Correlation and Regression. Testing of Hypotheses: Analysis of Variance & covariance. Types of errors and level of significance. Tests of significance: t-Tests, chi-Square Tests and ANOVA.</p>		

- *Microsoft First Look Office 2010, K. Murray, Microsoft Press. New Delhi : Wiley Eastern Limited.*
- *New Delhi: Wishwa Prakashan. Fundamentals Of Computers, Dr. P. Mohan, Himalaya Publishing House.*
- *A Biologists guide to Principles and techniques of practical Biochemistry, B.D.williams (Edward Arnold).*
- *Arora P.N. & Malkhan P.K. 1997: Biostatistics, Himalaya publication*
- *Glover T. and Mitchell K. 2002: Introduction to biostatistics, McGraw Hill NY*
- *Mahajan , S. K. : Introductory statistics for Biology*
- *Rosner Bernard 1999: Fundamentals of Biostatistics Duxbury Press.*
- *Upadyay A., Upadyay K. and Nath N. 2009: Biophysical chemistry: Principles and techniques. Himalaya publishing.*
- *Wilson K. and Walker J. 2004: Principles and Techniques of Practical Biochemistry, Cambridge University Press, Cambridge.*

M.Sc. MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB A01		COURSE TYPE: ECC	
COURSE TITLE: CELL BIOLOGY and GENETICS			
CREDIT: 06		TEACHING HOURS: 90	
MARKS: 100		THEORY EXAM. : 70 CCA: 30	
OBJECTIVE: To inculcate within the students basic knowledge regarding the origin of cells and cellular organization, cell behaviour, cellular processes and molecular events taking place within the cellular environment.			
UNIT-1 18 Hours	The origin and evolution of cell, Cell theory, The basic cell types – Prokaryotes and Eukaryotes, Cell organelles: Mitochondria, Golgi, endoplasmic reticulum, lysosomes, peroxisomes plastids, vacuoles and functions of cell organelles. Nucleus: Nuclear envelope, nucleolus, chromosomes, Membrane structure and Function.		
UNIT-2 18 Hours	Transport across the membrane: Simple and facilitated diffusion, Osmosis, Passive and active transport, Na ⁺ /K ⁺ pump. Cytoskeleton: Microtubules, intermediate filaments and microfilaments. Cell motility: Cilia and flagella of prokaryotes and eukaryotes.		
UNIT-3 18 Hours	Mitosis (Behaviour of chromosomes, formation of mitotic spindle, Sister chromatid separation), Cytokinesis, Meiosis, Gametogenesis and fertilization. Cell cycle –molecular events, Check points. Cdk – cyclin complexes & their role in cell cycle regulation. Apoptosis, Tumor suppressor genes and oncogenes (p53 and pRB) & cancer.		
UNIT-4 18 Hours	Cell signaling: exocrine, endocrine and paracrine signaling, Surface and intracellular receptors, receptor mediated transduction (G-Proteins, DAG, Ca ⁺² Calmodulin, c-AMP). Cellular responses to environmental signals in plants and animals, bacterial chemotaxis and quorum sensing		
UNIT-5 18 Hours	Gene concept, alleles/multiple alleles, Types of gene. Mendelian laws of inheritance. Extensions of mendelian principles, linkage and crossing over. Sex linked inheritance Extra chromosomal inheritance		

- *Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff. Keith Roberts, Peter Walter, (2002), Molecular Biology of the Cell, IV edition, Garland Publishing, New York*
- *Geoffrey M. Cooper, Robert E. Hausman, (2007). The Cell – A Molecular Approach, Sinauer Associates, Inc.*
- *Lodish et al (2000) Molecular Cell Biology, Fourth Edition, W.H. Freeman and Company, New York.*
- *De Robertis E D P, Saez F A, De Robertis E M F (2008) Cell Biology, 6th Edition, Saunders.*
- *Karp G, Iwasa J, Marshall W (2016) Cell and Molecular Biology: Concepts and Experiments, 8th Edition, Wiley.*

M.Sc. MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB A02		COURSE TYPE: ECC/CB	
COURSE TITLE: ENZYMOLOGY & ENZYME TECHNOLOGY			
CREDIT: 06		TEACHING HOURS: 90	
MARKS: 100		THEORY Exam. : 70	CCA: 30
<p>OBJECTIVE: Enzymes are the bio-catalysts involved in numerous bio-chemical reactions within the cell. More importantly enzyme activity is also observed <i>in-vitro</i> under appropriate conditions and hence enzymes can also be utilized outside the cellular environment as in industrial fermentation, research purposes etc. in this regards, this paper aims to impart the students the basic knowledge concerning enzyme functioning, kinetics, industrial application to help students pursue their career in this field in future.</p>			
UNIT-1 18 Hours	Introduction to Enzymes, enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turnover number, Marker enzymes.		
UNIT-2 18 Hours	Enzyme Kinetics: Steady state, pre-steady state, equilibrium, kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the Km and Vmax and their significance.		
UNIT-3 18 Hours	Factor affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.		
UNIT-4 18 Hours	Structure and function of enzymes: Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.		
UNIT-5 18 Hours	Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, Catalytic antibodies - abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes.		

- *A textbook of Enzyme Biotechnology* By Alan Wiseman.
- *Advances in Enzymology: v. 47 (Hardcover)* By Alton Meister. John Wiley and Sons Inc.
- *Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover)* By D Voet. John Wiley
- *Enzymes* By M Dixon and EC Webb. EC Longmans, London.
- *Enzymes: Biochemistry, Biotechnology and Clinical Chemistry* By Trevor Palmer.
- *Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (Paperback)*By Nicholas C. Price and Lewis Stevens. Oxford University Press.
- *Lehninger Principles of Biochemistry 4th Ed* By David L. Nelson and Michael M. Cox, WH Freeman and Company.
- *Nature of Enzymology* By RL Foster
- *Principles of Biochemistry (Hardcover)*By Geoffrey Zubay. Publisher: McGraw Hill College.

M.Sc. MICROBIOLOGY		I SEMESTER	
COURSE CODE: MMB A03		COURSE TYPE: ECC/CB	
COURSE TITLE: SCIENCE & TECHNOLOGY FOR RURAL DEVELOPMENT			
CREDIT: 06		THEORY HOURS: 90	
MARKS: 100	THEORY Exam. : 70	CCA: 30	
<p>OBJECTIVE: The real India lives in the Indian villages. The main occupation of the villagers is agriculture and animal and related works. Till the date not much change is evidenced in the village scenery. The problem of waste management, hygiene, balanced food, etc. and yet more still prevails in our villages, in this regards, this paper aims to give the students insights of some simple yet efficient techniques to deal with such problems and comfort the life, raise the life standards and present new options for the economic growth.</p>			
UNIT-1 20 Hours	<p>Microbial inoculants- Selection & establishment of nitrogen fixing bacteria. Production of Rhizobium, Azotobacter, Azospirilla, cyanobacteria and other nitrogen fixing bacterial cultures. Quality control of bio inoculants; Phosphate solubilising bacteria; mycorrhiza; plant growth promoting rhizobacteria (PGPR); Biocontrol microbial inoculants.</p>		
UNIT-2 20 Hours	<p>Role of microorganisms for Biomonitoring of various quality-parameters related to water and wastewater - Indicator organisms, single species laboratory bioassays and biosensors. Brief introduction to various stages of wastewater treatment: Primary, secondary and tertiary treatment. Control of pathogens in water and wastewater. Use of microorganisms for removal of various toxins and metallic ions from wastewater.</p>		
UNIT-3 20 Hours	<p>Vermiculture: definition, scope and importance - common species for culture, culture methods, wormery breeding techniques - indoor and outdoor cultures - monoculture and polyculture - relative merits and demerits. Vermin-composting, use of vermicastings in organic farming / horticulture - earthworms for management of biomedical solid wastes - feed / bait for capture / culture fisheries - forest regeneration</p>		
UNIT-4 15 Hours	<p>Single cell protein: microorganisms used; raw material used as substrate; condition for growth and production; nutritive value and uses of SCP. Baker's yeast; Production of probiotic biomass; and mold cultures. cultivation of different types of mushroom; edible mushroom; therapeutic value of mushrooms.</p>		

UNIT-5 20 Hours	<p>Mass cultivation of cyanobacteria under outdoor and indoor conditions. Cyanobacteria as a source of fine chemicals, polysaccharides, bioactive molecules, pigments, antioxidants, lipids and polyunsaturated fatty acids. Cyanobacteria as biofertilizer for paddy cultivation. Hydrogen production by cyanobacteria: Mechanism, progress and prospects. Cyanobacterial and algal fuels</p>
SUGGESTED READINGS	<ul style="list-style-type: none"> • <i>Casida, Industrial microbiology-, L.E. New age international Ltd, Publishers. New Delhi:</i> • <i>Edwards, C.A. and Bohlen, P. J (1996) ecology of earthworms - 3rd Edition, Chapman and hall.</i> • <i>Frazier, Food microbiology. W.C. Tata McGraw Hill.</i> • <i>Jsmail, S.A., (1970) Vermicology, The biology of earthworms, Orient Longman, London.</i> • <i>L. M. Prescott, J. P. Harley and D. A. Klein. Microbiology-, McGraw Hill</i> • <i>Lee, K.E., (1985) Earthworms - Their ecology and Relationship with Soil and Land use, Academic Press, Sydney.</i> • <i>N. J. Pelczar, S. Chand, R. Krieg. Microbiology- Tata McGraw Hill</i> • <i>Robert A Andersen. (2005) Algal Culturing Techniques. Academic Press.</i> • <i>Sultan Ahmed Ismail, (2005) The Earthworm Book, Second Revised Edition. Mother India Press, Goa.</i>

M.Sc. MICROBIOLOGY

I SEMESTER

COURSE CODE: MMB 111

COURSE TYPE: PRACTICAL

COURSE TITLE: LAB (Lab Course 1)

CREDIT: 06

PRACTICAL HOURS: 90

MARKS: 100

LABORATORY WORK

1. Study of mitotic cell division in *Allium cepa*.
2. Effect of UV radiations on Phenotypic characteristics of bacteria.
3. Effect of UV radiation on Production of pigments in Fungi.
4. Isolation of DNA from Bryophillum leaves
5. To observe meiosis in onion flower buds of onion (smear method).
6. Observation of prokaryotic and eukaryotic cells and cell types
7. Media Preparation – Nutrient broth and Nutrient Agar, Potato Dextrose Agar.
8. Various Pure culture techniques
9. To study of effect of temp., pH, salt concentration, on microbial growth
10. Staining Techniques – Simple and Gram Staining, Spore and Capsule Staining, Fungal Staining, Acid Fast Staining.
11. Determination of Anti-Microbial Activity by Disc Diffusion method
12. Biochemical characterization of isolated microbes.
13. pH measurements and preparation of buffers
14. Separation of amino acids by paper chromatography and TLC
15. Titration of amino acids – Determination of pK and pI values.
16. Estimation of proteins by Lowry methods.
17. Estimation of reducing sugars by Benedict's titrimetric method
18. Determination of saponification number of lipids.
19. Determination of amylase, activity using a Spectrophotometer
20. Determination optimum temp. and pH for amylase activity (germinating seeds)
21. Qualitative tests for carbohydrates, alkaloids, terpenoids, fatty acids & phenolics

