ST. ALOYSIUS COLLEGE(AUTONOMOUS), JABALPUR

Reaccredited 'A+ 'Grade by NAAC(CGPA:3.68/4.00)
College with Potential for Excellence by UGC
DST-FIST Supported & STAR College Scheme by DBT

Faculty of Science

Master of Science (M.Sc.)

SUBJECT: MICROBIOLOGY

M.Sc. I Semester

Paper-CC11

Principles of Microbiology

Course Outcomes

CO. No.	Course Outcomes	Cognitive Level
The students should be able to:		
CO 1	Understand the general features and characteristics of microbes	U, A
CO 2	Know about the history of microbiology and microorganisms	U, A,
CO 3	Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity	U, A
CO 4	Learn about general methods and techniques to isolate and culture of microorganisms.	A

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	6	40	60 (Minimum Passing marks 24)	**100**
Practical	4	40	60 (Minimum Passing marks 24)	**100**
Total	**10**	**200**		

Content of the Course

Theory

No. of Lectures (in hours per week): 5 Hrs. per week
Total No. of Lectures: 60 Hrs. Maximum Marks: 60

Unit	Topics	No. of Lectures 60
1	Ancient History of Microbiology from Atharva Veda, Contribution of Risi Karva, Atri, Jamdagni and Agastya, origin and Prevalence of germs. Nomenclature of germs in Vedas, their classification based on Caraka, Historical development and scope of Microbiology-Contribution of scientists and spontaneous generation and germ theory, Classification and identification of microorganisms, polyphasic taxonomy. Bergey's Manual of determinative Bacteriology. *Activity* *1. Discussion on ancient origin of Life in Vedas.* *2. Slide preparation of microorganism from different environment.* *3. Chart preparation on Biodiversity of pathogenic and nonpathogenic microorganism.* *4. Demonstration of Bergey's, Manual of determinative Bacteriology.*	18
2	Techniques in Microbiology- Isolation, pure and enrichment culture, staining procedure, physical & chemical sterilization methods, physical and chemical agents-Antiseptics and disinfectants, Control of Microorganisms by Narrow and broad-spectrum antibiotics, Antifungal antibiotics, Preservation of bacterial cultures. Cultivation of bacteria aerobic, anaerobic, types of culture media. *Activity:* *1. Demonstration of pasteurization by visit to dairy industry.* *2. Survey of antiseptics and disinfectants available in local market.* *3. Preparation of chart of antifungal antibiotics with their biochemical activity.*	18
3	Morphology and ultrastructure of bacteria size, shape and arrangement, structure and chemical composition and function of cell walls of Gram positive and Gram-negative bacteria; Structure, composition and function of cell rnembrane, capsule; flagella, pilli, gas vesicles, cytoplasmic matrix, reserve food materials; chromosomes, carboxysomes. magnetosomes and phycobilisomes; nucleoid. Reproduction and Recombination in bacteria. Nature and properties of spores: Bacterial exo and endospores, Germination of spores. Antibiotic resistance mechanisms and multiple drug resistance. Diversity of Microbesarchaea, Photosynthetic bacteria and Cyanobacteria	18

	Activity: *1. Preparation of model of Gram positive and Gram-negative cell wall.* *2. Comparative chart preparation of prokaryotic & Eukaryotic cells* 3. *Quiz of diversity of cyanobacteria and Photosynthetic activity*	
4	Current status of fungi; their classification with reference to Ainsworth; General characters, somatic structure, asexual and sexual reproduction of microbiologically important genera of Myxomycota, Mastigomycotina. Zygornycotina, Ascomycotina, Basidiomycotina and Deuteromycotina; Heterothallism; sex hormones in fungi; physiological specialization and phylogeny of fungi. Parasexual life cycle; Symbiotic associations of fungi with algae; Economic importance of fungi. General characters of algae; classification of algae; Somatic structure, asexual and sexual reproduction of Chlorophyceae, Phaeophyceae, Bacillariophyceae and Rhodophyceae. Microbial ecology General characteristics, structure, nomenclature and classification of microbial, animal and plant viruses. Disease symptomatology, transmission and diagnostic techniques of animal and plant viruses. Bacteriophages: structural organization, lytic and lysogenic cycle. Viroids, and virusoids. Prions and its diseases. General characters of protozoans; Structure and reproduction in protozoans: Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma and Plasmodium, Paragonimus, Fasciola hepatica, Schistosoma *Activity* *1. Make tree chart of imported gene of fungi.* *2. Collection of Symbiotic associations of fungi with algae from forest.* *3. Chart preparation of fresh water algae from marshy water bodies*	18
5	The definition of microbial growth, Growth in batch culture, Mathematical representation of bacterial growth, Bacterial generation time, Specific growth rate, Monoauxic, Diauxic and synchronized growth curves, Measurement of microbial growth, Factors affecting microbial growth. Brief account of growth in fungi, Culture collection and maintenance of microbial cultures, Principles of microbial nutrition Chemoautotrophs, chemoheterotrophs, photoautotrophs and photo heterotrophs. *Activity* *1. Chart making on Monoauxic, Diauxic and synchronized growth curves,* *2. Demonstrate of various methods of microbial growth measurement.* *3. Visit to different microbial culture collection centre.*	18
Books and other Learning Resources		

Suggested Readings:

1. Tortora, Funke & Case. Microbiolory: An Introduction7th Edition. 2001
2. M.J.Pelczar, E.C.S. Chan, N.R. Krieg. Microbiology VI Edition: New York: McGrawHill. 2001.
3. R. Y. Stainier, J. L. Ingraham, M. L. Wheelis and P.R. General Microbiolory: Painter. Publisher: Macmillan.
4. Matthai, W., Berg, C.Y. & Black, J.G. Boston, MA: Microbiology, Principles and Explorations: John Wiley & Son. 2005.
5. Willey, J.M., Sherwood, L., Woolverton, C.J., Prescott, L.M. & Willey, J.M., Prescott's . Microbiology: New York: McGraw-Hill. 2011.
6. Pommerville, J.C., Alcamo's Jones and Bartlett Fundamentals of Microbiology (10th Ed.): Learning. 2013.
7. Madigan, MT, Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A.,Biology of Microorganisms (15th Ed.): Brock Pearson/ Benjamin Cummings. 2018.
8. Sequeira, M., Kapoor, K.K., Yadav, K.S. & Tauro, P.,An Introduction to Microbiology (3rd Ed.): New Age International Publishers. 2019.
9. Relevant book published in Hindi Granth Academy.
10. Dubey R.C. & Maheshwari D.K., A Textbook of Microbiology, 5th edition S. Chand Publishing, 2023.
11. H. D. Kumar, Daya Agricultural Biotechnology Publishing House, 2006
12. P.S. Bisen and Kavita Verma, Handbook of Microbiology, CBS publishers and distributors Pvt Ltd 2021
13.B. D. Singh, Biotechnology, 4 th Edition Kalyani Publishers, 2010.
14.Books published by M.P. Hindi Granth Academy, Bhopal

Part D : Assessment and Evaluation (Theory)		
Maximum Marks: Continuous Comprehensive Evaluation (CCE): University Exam (UE): Time: **03.00 Hours**		**100** **40** **60**
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test	**20**
	Assignment/Presentation	**20**
	Total	**40**
External Assessment: University Exam	Section (A) : Three Very Short Questions (50 Words Each)	03 x 02 = 06
	Section (B) : Four Short Questions (200 Words Each)	04 x 08 = 32
	Section (C) : Two Long Questions (500 Words Each)	02 x 11 = 22
	Total	**60**

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List of Practical

Part A: Introduction					
Program-		**Class: M.Sc.**	**Year: I**	**Semester: I**	**Session: 2025-2026**
Subject: Microbiology					
1	**Course Code**	**PC-11**			
2	**Course Title**	**Lab work for Principles of Microbiology (Practical-I)**			
3	**Course Type**	**Core Course**			
4	**Pre-requisite (If any)**	**To study this course a student must have had the subject B.Sc. with Biology.**			
5	**Course Learning outcomes (CLO)**	The objectives of this course are to introduce the field of microbiology with special emphasis on microbial (Bactria, Fungi and virus) diversity, morphology, growth and nutrition; methods for control of microbes and viruses. **CLO** The students should be able to: - 1. Understand the general features and characteristics of microbes. 2. Know about the history of microbiology and microorganisms. 3. Identify major categories of microorganisms and analyze their classification, diversity, and ubiquity; 4. Learn about general methods and techniques to isolate and culture of microorganisms.			
6	**Credit Value**	**4**			
7	**Total Marks**	**Max. Marks: 40+60**	**Min. Passing Marks : 40**		

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week Total Lectures: 120 hours

List of Practicals

1. Sterilization, disinfection and safety in microbiological laboratory.
2. Media Preparation for Cultivation of Microorganisms.
3. Isolation of bacteria in pure culture by streak plate method.
4. Study of colony and growth characteristics of some common bacteria.
5. Preparation of bacterial smear and Gram's staining.
6. Enumeration of bacteria: standard plate count.
7. Growth–Factors affecting growth. Sporulation, Growth curve of bacteria in batch culture.
8. Antimicrobial sensitivity test and demonstration of drug resistance.
9. Maintenance of stock cultures: slants, stabs and glycerol stock cultures
10. Determination of phenol coefficient of antimicrobial agents.
11. Determination of Minimum Inhibitory Concentration (MIC)
12. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
13. Enrichment culture technique–isolation of asymbiotic, symbiotic nitrogen fixing bacteria.
14. Determination of viable and total number of cells.
15. Measurement of cell size. and spore germination in bacteria.
16. Protoplasts formation.
17. Inactivation of microorganisms by different mutagens. Production, isolation and characterization of mutants. Determination of mutation rate.
18. Determination of soil microbial population; Soil microbial biomass; Decomposition studies in soil, Soil enzymes; Study of rhizosphere effect.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Cappuccino, J.G., & Welsh, C., Microbiology: a Laboratory Manual. Benjamin-Cummings Publishing Company. 2016.
2. Collins,C.H.,Lyne,P.M.,Grange,J.M.,&FalkinhamIII,J.CollinsandLyne'sMicrobiological Methods (8th Ed.). Arnolds. 2004.
3. Tille,P.M.,Bailey&Scott'sDiagnosticMicrobiology(14thEd.).Elsevier.2017.
4. Kapoor,K.K.&Paroda,S.,ExperimentalSoilMicrobiology.CBSPublishers.2007. Garg,F.C.,ExperimentalMicrobiology.CBSPublishers&Distributors.2005.
5. Tortora, Funke & Case. Microbiolory: An Introduction7th Edition. 2001
6. M.J.Pelczar, E.C.S. Chan, N.R. Krieg. Microbiology VI Edition: New York: McGraw- Hill. 2001.
7. R. Y. Stainier, J. L. Ingraham, M. L. Wheelis and P.R. General Microbiolory: Painter. Publisher: Macmillan.
8. Matthai, W., Berg, C.Y. & Black, J.G. Boston, MA: Microbiology, Principles and Explorations: John Wiley & Son. 2005.
9. Willey, J.M., Sherwood, L., Woolverton, C.J., Prescott, L.M. & Willey, J.M., Prescott's . Microbiology: New York: McGraw-Hill. 2011.
10. Pommerville, J.C., Alcamo's Jones and Bartlett Fundamentals of Microbiology (10th Ed.): Learning. 2013.
11. Madigan, MT, Bender, K.S., Buckley, D.H., Sattley, W.M. & Stahl, D.A.,Biology of Microorganisms (15th Ed.): Brock Pearson/ Benjamin Cummings. 2018.
12. Sequeira, M., Kapoor, K.K., Yadav, K.S. & Tauro, P.,An Introduction to Microbiology (3rd Ed.): New Age International Publishers. 2019.
13. Relevant book published in Hindi Granth Academy.
14. Dubey R.C. & Maheshwari D.K., A Textbook of Microbiology, 5th edition S. Chand Publishing, 2023.
15. H. D. Kumar, Daya Agricultural Biotechnology Publishing House, 2006
16. P.S. Bisen and Kavita Verma, Handbook of Microbiology, CBS publishers and distributors Pvt Ltd 2021
17. B. D. Singh, Biotechnology, 4th Edition Kalyani Publishers, 2010.
18. Books published by M.P. Hindi Granth Academy, Bhopal

Part D - Assessment and Evaluation (Practical)	
Scheme of Practical Examination: -	**Max. Marks: 40 +60 =100**
Internal Assessment	**Max. Marks-40**
Class Interaction	10
Quiz	10
Seminar	10
Assignments (Charts, Rural Service, Technology Dissemination/ Excursion/ Lab Visit/Industrial Training	10
External Assessment	**Max. Marks-60**

Major experiment	10
Minor Experiment-1	10
Minor Experiment-2	10
Spotting	10
Viva-Voce	10
Practical Record	10

Faculty of Science

Master of Science (M.Sc.)

SUBJECT: MICROBIOLOGY

M.Sc. I Semester

Paper-CC12

Microbial Biochemistry and Genetics

Course Outcomes

CO. No.	Course Outcomes	Cognitive Level
The students should be able to:		
CO 1	Gain fundamental knowledge on structure, functions and metabolism of biomolecules.	U
CO 2	To understand the microbial genetics of microbes. Learn about gene expression.	U, A,

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	6	40	60 (Minimum Passing marks 24)	**100**
Practical	4	40	60 (Minimum Passing marks 24)	**100**
Total	**10**	**200**		

Content of the Course

Theory

No. of Lectures (in hours per week): 5 Hrs. per week
Total No. of Lectures: 60 Hrs. Maximum Marks: 60

Unit	Topics	No. of Lectures 60
1	Origin of Universe-Cosmogony, God particle, Big Bang theory, Atoms and Molecules in Vedic period. An introduction, General structure and important features of carbohydrates, glycoproteins & glycolipids. Metabolism of Carbohydrates-Glycolysis, Feeder pathways, Citric acid cycle, Gluconeogenesis and their regulations, Glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, Roles of epinephrine and glucagon and insulin in glycogen metabolism; Starvation responses and insulin signalling. Glyoxylate and Pentose phosphate pathways. *Activity* *1. Discussion on chronological order of creation.* *2. Chart formation on Glucose metabolism or Pentose Phosphate pathways.* *3. Model preparation of the DNA double helix structure*	18
2	Definition and classification of lipids. Structure and functions of major lipid subclasses- Acylglycerols, Phospholipids, Glycolipids, Sphingolipids, Waxes, Terpenes and Sterols. Fatty acids biosynthesis, degradation and their regulations, Hormone trigger mobilization of stored triacylglycerol, Oxidation of fatty acidssaturated (odd and even carbon) and unsaturated, Ketone bodies synthesis. Biosynthesis of TAG, Phospholipids and Glycolipids. Mevalonate pathway. *Activity* *1. Chart preparation on major lipid subclasses.* *2. Flow chart format of fatty acids degradation.* *3. Demonstration and application of Mevalonate pathway.*	18
3	Amino Acids- structure, classification and properties. Handerson and Hasselbach equation for ionization of amino acids, Reverse turns and Ramachandran plot. Structure- function relationships in model proteins like, myoglobin, hemoglobin, chymotrypsin etc. A brief account of amino acid biosynthesis and degradation, Urea cycle and its regulation. Chemical synthesis of peptides and small proteins. Protein sequencing. *Activity* *1. Demonstration of Handerson and Hasselbach equation.* *2. Compuation and Chart preparation of myoglobin, hemoglobin, chymotrypsin etc.* *3. Quiz on protein sequencing.*	18
4	Enzymes as biocatalysts- Enzyme classification. Mechanism of enzyme action-specificity, active site, activity unit and isozymes. Factors affecting enzyrne efficiency, enzyme activators, coenzymes and cofactors. Enzyme kinetics - Michaelis - Menton equation for simple enzymes, determination of kinetic parameters, multi-step reactions and rate limiting steps. Enzyme inhibition- reversible, irreversible, competitive and noncompetitive. Allostersim- kinetic analysis of allosteric enzymes, Principles of allosteric regulation. *Activity*	18

	1. Discuss on enzyrne, coenzymes and cofactors. *2. Demonstration of allosteric regulation by model.* *3. Online visualization of enzyme inhibition.*	
5	Fine structure of nucleic acid, DNA replication, DNA damage and Repair pathways, Transcription-General Principles, basic apparatus and types of RNA polyrnerases. Initiation, elongation and termination steps, Maturation and processing of RNA: Methylation, cutting and trimming of rRNA; capping, polyadenylation and splicing of mRNA, Basic features of the genetic code, Wobble hypothesis, protein, synthesis; steps, details of initiation, elongation and termination, Regulation of gene expression: Operon concept, positive and negative regulation of lac operon; catabolite repression, inducers and co-repressors, arabinose and tryptophan operon. Biosynthesis and degradation of purines and pyrimidines, Salvage pathway. *Activity* *1. Chart making on type of RNA polymerases.* *2. Quiz on DNA damage and repair pathway.* *3. Discussion of Salvage pathway.*	18

Books and other Learning Resources

Suggested Readings:

1. Stryer, L., Biochemistry. (8th Ed.): New York: Freeman. 2015.
2. Nelson, D.L. & Cox, M.M. Lehninger, A.L. Principles of Biochemistry (7th Ed.): Lehninger New York, NY: Worth. 2017.
3. Voet, D. & Voet, J.G.,Hoboken, NJ: J. Biochemistry (5th Ed.): Wiley & Sons.
4. Martin. P. A and Rodwell. V. M.D.W, Mayes. Harper's review of Biochemistry
5. B. Lewin. Gene VII.
6. P. K. Gupta. Genetics
7. B.D. Singh. Genetics
8. H.D. Kumar. Microbial Genetics
9. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. https://onlinecourses.nptel.ac.in/noc25_bt33/preview
2. https://www.coledavid.com/downloads/datadownloads/chapter_1_biomolecules.pdf
3.https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001202/M010962/ET/1526556203Module_23_ET.pdf
4. https://uw.pressbooks.pub/fmrbiochemistry/chapter/main-body-3/

5. https://ebooks.inflibnet.ac.in/biocp04/chapter/glycolysis/
6. https://egyankosh.ac.in/bitstream/123456789/75923/1/Unit-13.pdf
7.https://www.medschool.lsuhsc.edu/biochemistry/Courses/Biochemistry201/Desai/Amino%20Acid%20Metabolism%20I%2010-14-08.pdf
8. https://basu.org.in/wp-content/uploads/2020/06/Enzymes.pdf
9. https://biochem.du.ac.in/userfiles/downloads/Enzyme%20Kinetics.pdf
10. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/223/6898/et/15200319060603031212.pdf
11. https://rwu.pressbooks.pub/bio103/chapter/regulation-of-gene-expression/
12. http//www.mphindigranthacademy.org

Part D : Assessment and Evaluation (Theory)		
Maximum Marks: Continuous Comprehensive Evaluation (CCE): University Exam (UE): Time: **03.00 Hours**		**100** **40** **60**
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Class Test	**20**
	Assignment/Presentation	**20**
	Total	**40**
External Assessment: University Exam	Section (A) : Three Very Short Questions (50 Words Each)	03 x 02 = 06
	Section (B) : Four Short Questions (200 Words Each)	04 x 08 = 32
	Section (C) : Two Long Questions (500 Words Each)	02 x 11 = 22
	Total	**60**

Note: There will be a Seminar of 2 credits in First Semester, of which topics, may be taken from the syllabus of CC-11 and CC-12

Part A: Introduction					
Program-		**Class: M.Sc.**	**Year: I**	**Semester: I**	**Session: 2025-2026**
Subject: Microbiology					
1	**Course Code**	**PC-12**			
2	**Course Title**	**Lab work for Microbial Biochemistry and Genetics (Practical-II)**			
3	**Course Type**	**Core Course**			
4	**Pre-requisite (If any)**	To study this course a student must have had the subject B.Sc. with Biology.			
5	**Course Learning outcomes (CLO)**	**Course Outcomes (Cos):** Objectives of this course are to build the knowledge of biochemical principles with a specific emphasis on different metabolic pathways and microbial genetics. Course content highlights the Biochemistry, metabolism and genetics of microbes. Understand basic aspects of Bioenergetics and metabolism of microbes. The content of this course, students should be able to: - 1. Gain fundamental knowledge on structure, functions and metabolism of biomolecules. 2. To understand the microbial genetics of microbes. Learn about gene expression.			
6	**Credit Value**	**4**			
7	**Total Marks**	**Max. Marks: 40+60**	**Max. Marks: 40+60**		

Part B: Content of the Practical Course

Total numbers of Lectures (in hours per week): 8 hours per week/credit

Total Lectures: 120 hours

List of Practical

1. Preparing various stock solutions and working solutions that will be needed for the course.
2. To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
3. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating Beer-Lambert's Law.
4. Separation of aliphatic, aromatic and polar amino acids by paper chromatography.
5. Separation of lipids by thin-layer chromatography.
6. Purification and characterization of an enzyme from a natural/recombinant source (suchasAlkalinePhosphataseorLactateDehydrogenaseoranyenzymeofchoice).
7. Preparation of cell-free lysates
8. Ammonium Sulfate precipitation
9. Ion-exchange Chromatography
10. Gel Filtration Chromatography
11. Affinity Chromatography
12. Dialysis of the purified protein solution against60%glycerol as a demonstration of storage method.
13. Assessing the purity of samples from each step of purification by SDS-PAGE/ Gel Electrophoresis\
14. Enzyme Kinetic Parameters: Km, Vmax and $K_{cat.}$
15. Experimental verification that absorption at OD 260 is more for denatured DNA as compared to native double stranded DNA. Reversal of the same following DNA renaturation. Kinetics of DNA renaturation as a function of DNA size.
16. Identification of an unknown sample as DNA, RNA or protein using available laboratory tools.

Part C: Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Stryer, L., Biochemistry. (8th Ed.): New York: Freeman. 2015.
2. Nelson, D.L. & Cox, M.M. Lehninger, A.L. Principles of Biochemistry (7th Ed.): Lehninger New York, NY: Worth. 2017.
3. Voet, D. & Voet, J.G.,Hoboken, NJ: J. Biochemistry (5th Ed.): Wiley & Sons.
4. Martin. P. A and Rodwell. V. M.D.W, Mayes. Harper's review of Biochemistry
5. B. Lewin. Gene VII.
6. P. K. Gupta. Genetics
7. B.D. Singh. Genetics
8. H.D. Kumar. Microbial Genetics
9. Sawhney,S.K.&Singh,R., Introductory Practical Biochemistry,NarosaPublishingHouse.2009.
10. Plummer,D., An Introduction to Practical Biochemistry (3rdEd.).McGrawHillEducation.2017.
11. Sadasivam, S., Biochemical Method (3rdEd.).New Age International PvtLtdPublishers.2018.
12. Jayaraman, J., Laboratory Manual in Biochemistry. New Age International Private Limited. 2011.
13. Books published by M.P. Hindi Granth Academy, Bhopal

Suggested equivalent online courses:

1. https://onlinecourses.nptel.ac.in/noc25_bt33/preview
2. https://www.coledavid.com/downloads/datadownloads/chapter_1_biomolecules.pdf
3. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001202/M010962/ET/1526556203Module_23_ET.pdf
4. https://uw.pressbooks.pub/fmrbiochemistry/chapter/main-body-3/
5. https://ebooks.inflibnet.ac.in/biocp04/chapter/glycolysis/
6. https://egyankosh.ac.in/bitstream/123456789/75923/1/Unit-13.pdf
7. https://www.medschool.lsuhsc.edu/biochemistry/Courses/Biochemistry201/Desai/Amino%20Acid%20Metabolism%20I%2010-14-08.pdf
8. https://basu.org.in/wp-content/uploads/2020/06/Enzymes.pdf
9. https://biochem.du.ac.in/userfiles/downloads/Enzyme%20Kinetics.pdf
10. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/223/6898/et/1520031906060303 1212.pdf
11. https://rwu.pressbooks.pub/bio103/chapter/regulation-of-gene-expression/
12. http//www.mphindigranthacademy.org

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Part D - Assessment and Evaluation (Practical)	
Scheme of Practical Examination: -	**Max. Marks: 40 +60 =100**
Internal Assessment	**Max. Marks-40**
Class Interaction	10
Quiz	10
Seminar	10
Assignments (Charts, Rural Service, Technology Dissemination/ Excursion/ Lab Visit/Industrial Training	10
External Assessment	**Max. Marks-60**
Major experiment	10
Minor Experiment-1	10
Minor Experiment-2	10
Spotting	10
Viva-Voce	10
Practical Record	10

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