Govt. E. Raghavendra Rao Postgraduate Science College, Bilaspur (CG)

DEPARTMENT OF MICROBIOLOGY

SYLLABUS

SESSION
2023 -2024

M.Sc.
(SEMESTER SYSTEM)
(SEMESTER I to IV)

Session 2023-24

SCHEME OF COURSE CURRICULUM

M.Sc. First Semester

MICROBIOLOGY

THEORY PAPER

Paper	Paper code	Title	Marks
First	CCMB-101	General Microbiology and Bacteriology	80
Second	CCMB-102	Virology and Phycology	80
Third	CCMB-103	Mycology and Protozoology	80
Fourth	CCMB-104	Biochemistry	80

PRACTICAL PAPER

First:		100
Second:		100
Internal Assessment:		
Test of each Paper for 10 marks*:	10 x 4 =	40
Seminar of each Paper for 10 marks:	10 x 4 =	40
Total		**600**

***Internal test:** Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.*

*** **Question Papers:** It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve, each question carrying equal (15) marks. Each type of question shall cover the entire syllabus.*

Syllabus in detail, as above has been enclosed herewith and is being recommended hereby-

Name and Signature of Convener & Members of B.O.S.:

Session 2023-24

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PAPER – I

CCMB-101 (General Microbiology and Bacteriology)

----------Max. Marks – 80------

Introduction, history and scope of Microbiology: Microorganisms their general characteristics. Scope of Microbiology, contribution of eminent scientists (Antony Von Leeuwenhoek, Edward Jenner, Louis Pasture, Robert Koch). Spontaneous generation conflict. Concept of prokaryotes & Eukaryotes; General Characters and Structure of Viruses, Mycoplasma, Archeabacteria, Bacteria, Microalgae, Cyanobacteria, Fungi, Actinomycetes, Rickettssia and Protozoa, their mode of reproduction and economic importance. **(Teaching 20 hrs)**

Bacterial Taxonomy: Haeckel's, Whittaker's and Carl Woese's concepts of Bacterial classification. Modern trends in the classification of microbial world. Introduction to the Bergey's Manual of Determinative Bacteriology. General characters of major groups of Eubacteria and Archeabacteria. **(Teaching 20 hrs)**

Bacterial Morphology: Morphology of Eubacteria and Archaebacteria, ultra-structure, L- form structure, cell wall and cell membrane. Structure and function of capsule, flagella, fimbriae, mesosome and cytoplasmic inclusions (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycean granules). Endospore – structure, development and germination. **(Teaching 20 hrs)**

Bacterial nutrition and cultivation: Nutritional and physical requirements for growth, growth media - complex, synthetic, differential and selective media and relevant bacterial characteristics. Cultivation of bacteria - aerobic, anaerobic and shaker still culture. Batch, continuous and synchronous culture. Bacterial growth - growth kinetics, growth curve, measurement of growth and environmental factors affecting growth. **(Teaching 20 hrs)**

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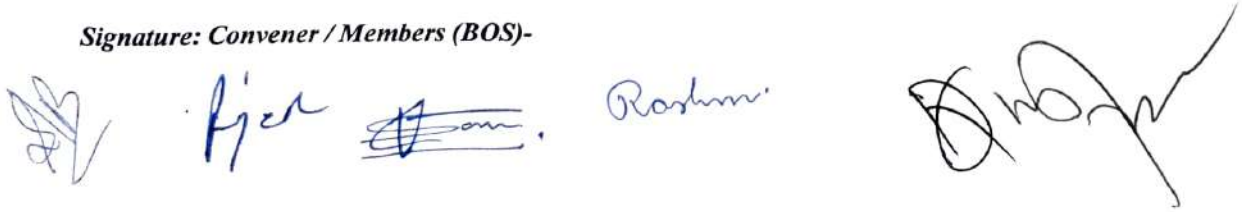
TEXT BOOKS:-

1. A. J. Salle, Fundamental Principles of Bacteriology.
2. Brock, T. D., Madigan M.T. Biology of Microorganisms. Prentice Hall Int. Inc.
3. Pelczar, M. J., Chan E.C.S. Kreig, N. R, Microbiology, Mc. Graw Hill.

Signature: Convener / Members (BOS)-



Session 2023-24

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PAPER – II

CCMB-102 (Virology and Phycology)

---------- **Max. Marks – 80**------

Discovery, taxonomy and structure of Viruses: General properties of viruses, morphology and ultra- structure of viruses, capsid and their arrangements, types of envelopes and their composition. Viral genome, their types and structure, viral related forms- virions, viroids, virusoids, and prions. **(Teaching 20 hrs)**

Plant and animal Viruses: Baltimore's Classification. Plant viruses- classification of plant viruses; Structure, pathogenicity and their transmission with/without vectors. Biochemical changes induced by virus in plant cell. Animal viruses - nomenclature and classification. Retroviruses and Oncogenic viruses, **(Teaching 20 hrs)**

Bacterial Viruses: Classification, morphology and ultra structure. One step growth curve (latent period, eclipse period and burst of size). Lytic and lysogenic life cycle. Cyanophage, general account of M13, T3, T4 and Lambda P1. **(Teaching 20 hrs)**

Introductory Phycology: General concept of Phycology, Fritch's classification of Algae. Basic structure of microbial algae, General account of Cyanobacteria- Nitrogen fixing and Non-Nitrogen fixing Cyanobacteria. Dinoflagellateae, Euglenoids and diatoms. Role of Algae in Microbiology. **(Teaching 20 hrs)**

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TEXT BOOKS:-

1. Medical Virology- by Morag C and Timbury M. C; Xth Edt. Churchill Livingstone London.
2. Introduction to Modern Virology- by Dimmock and Primrose (1994), IV Edt. Blackwell Scientific Publications, Oxford.
3. Functionals of Plant Virology- by Mathews, R. E. (1992), Academic press, San Diego.

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Session 2023-24

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PAPER – III

CCMB-103 (Mycology and Proto-zoology)

---Max. Marks – 80--------

General concept of Mycology: Basic classification and cellular organization of Fungi. General features, structure, nutrition, reproduction. Heterothallism and Para-sexuality. Sex hormones in fungi, physiological specialization, phylogeny of fungi, symbiotic association; lichen. **(Teaching 20 hrs)**

Important classes of fungi: General features, taxonomic status and evolutionary significance of important classes and relevant genera. Zygomycetes (Mucor, Rhizopus) Ascomycetes (Saccharomyces, Neurospora, Aspergillus), Basidomycetes(Agaricus, polyporus) and Deuteromycetes (Fusarium, Alternaria, Cercospora, Curvularia, Pestelosia, Cladosporium, Collettotricum). **(Teaching 20 hrs)**

General concept of protozoans: Basic classification of Protozoa. Occurrence, Ecology, Morphology and reproduction of Protozoa. Structure and reproduction and life cycle of important protozoans - Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma and Plasmodium. **(Teaching 20 hrs)**

Common Diseases: Important plant diseases caused by fungi- symptoms, disease cycles and control. Important human diseases caused by protozoans - their serology, disease symptoms, cycles, prevention measures and their control. **(Teaching 20 hrs)**

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TEXT BOOK:

1. Nester E.W, Anderson D.G.and Nester M.T.2006. Microbiology: A human perspective, Mc Graw-Hill.
2. Atlas R.M.1997.Principles of microbiology II Ed., McGraw Hill.
3. Lee.R.E.1999.Parasitology, Calcutta publication.
4. Talaro K. P. & Talaro A. 2006. Foundations of microbiology (6th Ed.), Mc Graw-Hill college Dimensi.
5. Wiley J., Sherwood L.and Woolverton C.2007. Prescott/Harley/Klein's Microbiology, McGraw Hill.

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Session 2023-2024

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PAPER – IV

CCMB-104 (Biochemistry)

---------- Max. Marks – 80------

Fundamentals of Biochemistry and Carbohydrates: General concept of Biomolecules, chemical bond, water molecules, stabilizing interaction (Vanderwaal's, electrostatic, hydrogen bonding, hydrophobic interaction), essential microelements, Role of monosaccharide (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, inulin); Isomers and derivatives of glucose, glucosamine and gluconic acid.

(Teaching 22 hrs)

Chemistry of Proteins, Lipids, Vitamins and Antibiotics: Structure of different types of protein, Ramachandran plot, protein biosynthesis and catabolism of protein. Classification of lipids, synthesis of fat, ß- oxidation. Vitamins- structure and function - types and their application. General account of antibiotics.

(Teaching 22 hrs)

Bioenergetics and strategy of metabolism: Flow of energy through biosphere, strategy of energy production of the cell, oxidation –reduction coupled reaction and group transfer, Electron transport chain and Oxidative Phosphorylation, ATP production, structural features of bio membranes, transport, free energy and spontaneity of reaction. G, G°, ΔG and equilibrium, basic concepts of acid, base, pH and buffers.

(Teaching 18 hrs)

Enzymes as biocatalysts: Enzyme classification, specificity, active site, activity unit, isoenzymes. Enzymes kinetics, Michalis - Menton eqation 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. **(Teaching 18 hrs)**

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TEXT BOOKS-

1. Biochemistry, Stryer 6th edition W.H. Freeman 20012.Principles of Biochemsitry Lehninger 3rd Edition by Nelson and Cox(Worth)2000.
2. Voet.D.& Voet.J.G.2005.Biochemistry,John Wileyand sons.Inc.
3. Berg J. M., Tymoczko J. L .& Stryer, L. 2007.Biochemistry, 6thEd.W.H.Freeman and Company, N.Y.
4. Nelson D. & Cox M. M. 2009. Principles of Biochemistry 5thEd.W.H. Freeman and Company, NewYork.
5. Talaro K. P. & Talaro A.2006. Foundations in Microbiology (6th Ed), McGraw-Hill College Dimensi.
6. Talaro K. P. and Talaro A. 2006. Foundations in Microbiology (6th Ed), Mc Graw-Hill.
7. Potter G.W.H & Potter, Geoffrey W.1995.Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kluwer Academic publishers.
8. Wiley J., Sherwood L.and Woowerton C.2007.Prescott/Harley/Klein's Microbiology. McGraw Hill.
9. Atlas R.M.1997.Principles of microbiology II Ed., McGraw Hill.

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SESSION 2023-2024

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-I
(CCMB-101 &CCMB-102)

1. **Preparation of Glassware:** Various techniques of cleaning (discarding & washing) and sterilization of glassware for microbiological laboratory.
2. **Preparation of Culture Media:** Different types of nutrient media as per nutritional need dehydrated, selective and differential media for autotrophic & heterotrophic microbes.
3. **Pure culture Techniques:** Preparation of slants, stab culture, sub-culturing, types of streaking.
4. **Staining Techniques:** Gram Staining, negative staining, acid-fast staining, endospore, capsule.
5. **Isolation, Identification and characterization of bacteria:** Cultural characteristics of bacteria (autotrophic & heterotrophic), using selective – differential media. Growth on NA. Blood agar. Chocolate agar, DCA, Maconkey's, EMB and Sabouraud's agar. Study of nutritional needs of bacterial growth (growth in the presence of different Source, N source).
6. **Biochemical test for identification of bacteria**: IMViC, catalase, oxidase, mannitol motility test, gelatin test, urease, TSI test, coagulase, nitrate reduction. Production of acid and gas from glucose, arabinose, inositol, lactose, maltose, mannitol, rhamnose, sucrose, xylose, fructose, starch hydrolysis, casein hydrolysis, assessment of effect of metals on microbial growth.
7. **Determination of growth of bacteria**: Growth curve and generation time.
8. **Isolation and identification of algae from soil and water**: Isolation and identification of cyanobacteria, extraction and separation of algal pigments.

Scheme of examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs.

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SESSION 2023-2024

M. Sc. FIRST SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-II
(CCMB-103 &CCMB-104)

1. Isolation and identification of fungi from different substrates (saprophytes, parasitic, coprophilous, keratinophilic).
2. Study of environmental requirements of fungi (pH, temperature) by linear growth and biomass.
3. Assessment of the effect of antifungal agents (antibiotics/ chemicals/ plant extracts) on isolated fungal samples.
4. Identification and characterization of protozoans as mentioned in course of studies (a case study of any one disease).
5. Pathological examination: Human diseases caused by protozoans as mentioned in course of studies (a case study of any one disease).
6. Colorimetric or spectrophotometric estimations of proteins, pigments, DNA, RNA and sugars.
7. Study of enzyme kinetics and enzyme activity: Isolation of amylase producing microorganisms from the environment; estimation of amylase activity and determining its Km and Vmax; effect of environmental conditions (temperature, pH and substrate concentration) on the activity of amylase.
8. Estimation of enzyme activity: Phosphatase and catalase.
9. Extraction and separation of amino acid and mycotoxin (aflatoxins) by paper chromatography.
10. Separation of isolated phospholipids by thin layer chromatography and hemoglobin by gel filtration.

Scheme of Examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

Signature: Convener / Members (BOS)-

SESSION 2023-2024

SCHEME OF COURSE CURRICULUM

M. Sc. Second Semester

MICROBIOLOGY

Paper	Paper code	Title	Marks
First	CCMB-201	Bioinstrumentation	80
Second	CCMB-202	Microbial genetics and Molecular Biology	80
Third	CCMB-203	Biostatics, Computer Fundamentals & Bioinformatics	80
Fourth	CCMB-204	Environmental Microbiology	80

PRACTICAL PAPER

First:		100
Second:		100

Internal Assessment:

Test of each Paper for 10 marks*:	10 x 4 =	40
Seminar of each Paper for 10 marks:	10 x 4 =	40
Total		**600**

***Internal test:** Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.*

*** Question Papers:** It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve, each question carrying equal (15) marks. Each type of question shall cover the entire syllabus.*

Syllabus in detail, as above has been enclosed herewith and is being recommended hereby-

Name and Signature of Convener & Members of B.O.S.:

CONVENER
Dr. D. K. Shrivastava
Prof. In-charge, Dept. of Microbiology

Session 2023-24

M. Sc. SECOND SEMESTER

MICROBIOLOGY

PAPER- I

CCMB-201 (Bioinstrumentation)

---------- **Max. Marks – 80----**

Basic laboratory Instruments & Microscopy: Principle and working of pH meter, turbidometer, BOD; Centrifugation – types of centrifuge machine, methods and their application. Basic principles for the examination of microbes by light, dark field, phase-contrast, confocal, florescent and electron (TEM & SEM) microscopy. **(Teaching 24 hrs)**

Chromatography: Concept, principle and application of Chromatographic techniques: Basic concepts, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC and FPLC and Gas Liquid Chromatography. **(Teaching 22 hrs)**

Spectroscopy: Spectrophotometry – basic concept and principle, law of absorption and radiation, principle and application of visible, ultraviolet, infrared and mass spectroscopy. Principle and application of NMR and ESR. **(Teaching 20 hrs)**

Electrophoresis: Principle, types and applications of frontal and zonal electrophoresis; paper electrophoresis. Principle, technique, application and limitations of starch gel, polyacrylamide and agarose gel electrophoresis. **(Teaching 20 hrs)**

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TEXT BOOKS:

1. Wilson K. & Walker J. 2008. Principles and Techniques of Biochemistry and Molecular Biology.6th Ed. Cambridge University Press.
2. Berg J. M., Tymoczko J. L. & stryer, L. 2007. Biochemistry 6thEd.W.H. Freeman and Company, New York.
3. Nelson D.& Cox M.M.2009. Principles of Biochemistry 5thEd.W.H. Freeman and company, New York.
4. Talaro K. P. & Talaro A. 2006 . Foundations in Microbiology 6thEd.W.H.Freeman and Company, New York. McGraw-Hill College Dimensi.
5. Potter G.W.H & Potter G.W.1995. Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques, Kulwer Academic Publishers.
6. Wiley J., Sherwood L. and Wool verton C.2007 .Prescott/Harley/Klein's Microbiology, McGraw Hill.

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Session 2023-24

M. Sc. SECOND SEMESTER

MICROBIOLOGY

PAPER- II

CCMB-202 (Microbial genetics and Molecular biology)

---------- **Max. Marks – 80**------

Basic concepts of Microbial Genetics: Nucleic acid as genetic material with experimental evidence. Bacterial transformation (types and mechanism), Transduction (Types and mechanism), Sexduction, Conjugation–F+ /Hfr / prime. Concept of transposable elements. **(Teaching 20 hrs)**

Nucleic Acid: Structure and types of DNA, DNA replication in prokaryotes and eukaryotes. Superhelicity in DNA; Melting of DNA; Linking number; Topological properties, mechanism of topoisomerases action. Types and structure of RNA; RNA polymerase; Ribozyme and splicing of RNA. Inhibition of RNA Synthesis. **(Teaching 22 hrs)**

Genetic code and Gene expression: Central dogma of molecular biology. Genetic code – concept, deciphering and properties. Protein synthesis in prokaryotes and eukaryotes - initiation, elongation & termination and factors involved in transcription & translation, inhibition of transcription & translation. Post translation modification of proteins. **(Teaching 22 hrs)**

Regulation of gene expression: Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing). Operon concept, negative and positive regulation, instability of bacterial mRNA, inducer and co-repressor, catabolic repression. Negative regulation – *E.coli.* operon; positive regulation – *E. coli.* Ara-operon; regulation by attenuation. **(Teaching 22 hrs)**

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TEXT BOOKS:

1. Benjamin Lewin. (2008) *Genes IX,* Jones and Bartlett Publishers Inc.
2. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James
3. Watson (2004), *Molecular Biology of the Cell*, 4th Edition, Garland Publishing
4. Raff, Keith Roberts, Peter Walter, (2003) *Essential Cell Biology*, 2nd Edition, Garland Publishing
5. Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004)
6. *Molecular Biology of the Gene,* 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing,

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Session 2023-24

M. Sc. SECOND SEMESTER

MICROBIOLOGY

PAPER- III

CCMB-203 (Biostatistics, Computer fundamentals and Bioinformatics)

---------- **Max. Marks – 80**-------

Fundamentals of Biostatistics: Statistical term, Sampling, data collection and presentation, Frequency distribution; Central tendency (mean, median and mode); Standard deviation and standard error. Concepts of Probability; ANOVA; Test of significance-Chi square test, t-test Correlation and Regression. **(Teaching 22 hrs)**

Overview of computer: Characteristics of computers, basic applications. Components of computer system; central processing unit, VDU, keyboard and mouse, input and output devices, computer memory, Concept of file, folder and directories, commonly used command. Number System: Binary, Octal, and Hexadecimal; Fixed and Floating Point Number Representations, Complements. **(Teaching 20 hrs)**

Computers and its Application: Generations of computer, basic data and information, basic data types, flow chart and basic of operating system (windows, unix), Classification of computers - mainframe computers and super computers; Introduction in MS office software(word, power point, excel) and its application. Basic ideas of computer languages, internet and website. Role of computer in laboratory and advance study of microbiology. **(Teaching 20 hrs)**

Bioinformatics: An overview, introduction and scope of bioinformatics. Kind of data used, information molecules basic structures of nucleic acids, DNA and RNA, DNA sequencing and Polymerase chain reaction (PCR), protein structure, functions, protein folding and characterization, Biological database: Types of databases (Entrez, SRS or sequence retrieval system). **(Teaching 22 hrs)**

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TEXT BOOKS:

1. Kenny J.F. and Keeping E.S.1964. Mathematics of statistics, part I & II, Affliated East-West press Ltd., New Delhi.
2. Bansi L1968, Mathematics of probability of statistics, Chand &Co. Delhi.
3. Snedcor G. W. & Cochram W.G. 1968. Statistical Methods, Oxford & IBH, Delhi. White R.2000.
4. Gralla P. 2000.How the internet work, Tech. Media.
5. Bailey N. T. J .2000.Statistical Methods in Biology, English Univ. Press.
6. Campbell R.C. 1974. Statistics for Biologist, Cambridge University Press UK.
7. Shina P. K. 2002. Fundamentals of Computers, BPB Publication, New Delhi.

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Session 2023-24

M. Sc. SECOND SEMESTER
MICROBIOLOGY

PAPER- IV

CCMB-204 (Environmental Microbiology)

---------- **Max. Marks – 80**--------

Aerobiology: Droplet nuclei, aerosol, assessment of air quality – solid, liquid pingements methods. Brief account of air borne transmission of microbes – bacteria and fungi, general account of air borne diseases and their preventive measures.

(Teaching 18 hrs)

Biogeochemical cycles: Carbon, nitrogen- phosphorus and sulphur, biofertilizers biological nitrogen fixation- (Rhizobium, Frankia)- non-symbiotic microbes Azotobacter, bioremediation, xenobiotics, biodegradation, biosensor and its application. Biodeteriotion- microbial deterioration of paper, textile, wood, leather, paint and metal corrosion. Principle methods for their protection.

(Teaching 22 hrs)

Aquatic microbiology- Water ecosystems: types – water (ponds lakes streams), marine habitats (Estuaries, mangroves, deep sea, hydrothermal vents, coral reefs), Zonation of water ecosystems – upwelling – eutrophication – food chain. Potability of water, microbial assessment of water quality, water purification. brief account of majorwater borne diseases and their control measures. **(Teaching 22 hrs)**

Waste treatment: Types and characterization of solid and liquid waste. Primary waste treatment, secondary waste treatment- oxidation pond, trickling filter, activated sludge, anaerobic digester (gasification), and tertiary treatment. Composting.

(Teaching 18 hrs)

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TEXTBOOKS:

1. Pepper I.L., Gerba C.P & Brusseau M.L.2006. Environmental and Pollution science, Academic Press.USA.
2. Johri, B.N. 2000.Extremophiles. Springer Verlag. New York.
3. Colwd D.1999.Microbial Diversity, Academic Press.
4. Atlas R.M. & Bartha R.1998.Microbiology Ecology – Fundamentals AND Applications. Addison Wesley Longman, Inc.
5. Campbell 1983. Microbial Ecology. R. k. Ckwe H publications.
6. Maier R. M. Pepper I. L. & Gerba C. P. 2000.Environmental Microbiology. Academic Press. USA.
7. Baker K.H. & Herson D.S.1994. Bioremediation, McGraw Hill Inc. N.Y.
8. Ralph M.A.1997. Environmental Microbiology, John Wileyand sons.Inc.
9. Forster C.F. & John D.A. 2000. Environmental Biotechnology, Ellis Horwood Ltd. Publication.
10. Christon J.H.2001. A. Manaual of environmental microbiology, ASM Publications.

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Session 2023-24

M. Sc. SECOND SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-I
(CCMB-201 &CCMB-202)

1. Studies on pH titration curves of amino acids/ acetic acid and determination of pKa values and Handerson-Hasselbach equation.
2. Separation of bacterial lipids/amino acids/ sugars/ organic acids by TLC or paper chromatography.
3. Separate of serum protein by horizontal submerged gel electrophoresis.
4. Paper electrophoresis and separation of hemoglobin or blue dextran by gel filtration.
5. Demonstration of PCR, DNA sequencer and fermenter.
6. Isolation of genomic DNA from bacteria and purification by column chromatography.
7. Isolation of genomic and plasmid DNA by polyethylene glycol method.
8. Restriction digestion of isolated DNA (single and double digestion).
9. DNA elution from agarose gel.
10. Purification of antibody by affinity chromatography.

Scheme of Examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

Signature: Members of BOS

Rashmi

Session 2023-24

M. Sc. SECOND SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-II
(CCMB-203 &CCMB-204)

1. Representation of statistical data by a) Histograms b) Ogive curves c) Pie diagrams.
2. Determination of statistical averages/ central tendencies. a) Arithmetic mean b) Median c) Mode
3. Determination of measures of dispersion- a) Mean deviation b) Standard deviation and coefficient of variation.
4. Test of significance- application of following a) chi-square test b) t- test c) standard error.
5. Computer operations- getting acquainted with different parts of computer. [DOS] and basics of operating a computer and creating files, folders and directories.
6. Applications of computers in biology using MS-office. a) MS-word b) Excel c) power point.
7. Creating an e-mail account, sending and receiving mails.
8. An introduction to INTERNET, search engines, websites, browsing and use of internet/ software for sequence analysis of nucleotides and proteins.
9. Studies of public domain, databases for nucleic acid and protein sequences and determination of protein structure (PDB), genome sequence analysis.
10. Isolation of microorganisms from different habitats. Soil water and air.
11. Potability test: potability of water (MPN and H_2S).
12. Physical, chemical and microbial analysis of water: color, pH, COD, BOD, total and dissolved solids.
13. Study of indoor and outdoor microflora of air by air sampling devices.
14. Study of microflora from industrial wastes and effluents.

Scheme of examination

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

Signature: Members of BOS

Session 2023-24

SCHEME OF COURSE CURRICULUM

M. Sc. Third Semester

MICROBIOLOGY

Paper	Paper code	Title	Marks
First	CCMB- 301	Immunology	80
Second	CCMB- 302	Medical Microbiology & Veterinary Microbiology	80
Third	CCMB- 303	Cell biology and Microbial physiology	80
Fourth	CCMB- 304	Enzymology and Biochemical techniques	80

PRACTICAL PAPER

First:		100
Second:		100
Internal Assessment:		
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Seminar of each Paper for 10 marks:	10 x 4 =	40
Total		**600**

***Internal test:** *Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.*

** ***Question Papers:*** *It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve, each question carrying equal (15) marks. Each type of question shall cover the entire syllabus.*

Syllabus in detail, as above has been enclosed herewith and is being recommended hereby-

Name and Signature of Convener & Members of B.O.S.:

Roshni

Dr. D. K. Shrivastava
Prof. In-charge, Dept. of Microbiology

Session 2023-24

M. Sc. THIRD SEMESTER
MICROBIOLOGY

PAPER –I

CCMB-301 (Immunology)

Max. Marks – 80

Immune system: History of immunology, cells and organs involved in immune system; virulence and host resistance; immunity- innate immunity and acquired immunity; immunohematology– blood groups, blood transfusion and Rh-incompatibilities.

(Teaching 22 hrs)

Antigens and antibodies: Antigens -structure and properties, types- iso and alloantigen; haptens and adjuvants, antigen processing and specificity. Immunoglobulin - structure, heterogenicity, types and sub-types, properties (physico-chemical and biological); Immunoglobulin gene arrangement. Theories of antibody formation; monoclonal antibodies and their applications.

(Teaching 20 hrs)

Antigen and antibodies reactions: *In-vitro* techniques: agglutination, precipitation, complement fixation, immunofluorescence, ELISA and radio-immune assay. *In vivo* technique: skin tests and immune complex demonstration. Applications of above methods in diagnosis of clinical diseases caused by microorganisms. **(Teaching 20 hrs)**

Hypersensitivity and complement: Immediate and delayed; antibody mediated Type-I anaphylaxis, Type-II; Antibody dependent cell cytotoxicity, Type-III; immune-complex mediated reactions and Type- IV; cell mediated hypersensitivity reactions; respective diseases, immunological methods for their diagnosis. Complement components, pathways and complement deficiencies.

(Teaching 22 hrs)

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TEXT BOOKS:

1. Immunology - Janis Kuby
2. Cellular and Molecular Immunology - Abul K. Abbas, Andrew H. Lichtman and Jordan S
3. Immunology: An Introduction - Ian R. Tizard

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Session 2023-24

M. Sc. THIRD SEMESTER
MICROBIOLOGY

PAPER –II
CCMB-302 (Medical and Veterinary Microbiology)

----------Max. Marks – 80------

Introduction of medical microbiology and concept of infection: Koch & River's postulates, role of microbiology in medicine of medically important microbes; microbial flora of human body. Microbial infection - types, stages and process. Mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggresins, depolymerizing enzymes, organotropism, variation and virulence. **(Teaching 22 hrs)**

Clinical Bacteriology: Morphological & biochemical characteristics, pathogenesis and laboratory diagnosis including rapid methods of following pathogenic bacteria; *Staphylococcus aureus*, Group A *Streptococci, Pneumococci, Neisseria*, members of the family *Enterobacteriaceae, Vibrio, Corynebacterium, Clostridia. Mycobacterium tuberculosis*, atypical *Mycobacterium*. New emerging infections: -*Streptococcus suis;* community associated methicillin resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, Multi drug resistant tuberculosis. **(Teaching 22 hrs)**

Clinical Mycology: Superficial, subcutaneous, cutaneous and systemic mycoses. General description of mycotic pathogens, their diagnosis and prevention. Pathogenic fungi: *Microsporum, Trichophyton, Histoplasma capsulatum, Blastomyces dermatitidis, Candida albicans, Cryptococcus neoformans.* **(Teaching 20 hrs)**

Veterinary Microbiology: General concept of veterinary microbiology, impact of diseases on poultry industry, mechanism of disease transmission. Fowl cholera, gangrenous dermatitis, avian pox, avian influenza (swine fever) mycoplasmosis, anthrax, coccidiosis, foot and mouth disease. **(Teaching 18 hrs)**

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TEXT BOOKS:

1. Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004 vol. 24 no. 3.
2. Textbook of Microbiology 8th edition 2009-Ananthnarayan & Paniker-University press.

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Session 2023-24

M. Sc. THIRD SEMESTER
MICROBIOLOGY

PAPER –III

CCMB-303 (Cell biology and Microbial physiology)

----------Max. Marks – 80-----

Bio membrane and Cell organelles: Lipid bilayer, membrane proteins, spectrins, glycophorin. Bacteriorhodopsin. Structure and functions of cell organelles: mesosome, ribosome, peroxisomes, endoplasmic reticulum, Golgi apparatus, mitochondria and chloroplasts, nucleus and cytoplasmic inclusions. **(Teaching 22 hrs)**

Cell division, cell cycle & cell communication: Mechanism and biochemical activities during M-phase. Cell cycle and Programmed cell death- Control system, intracellular control of cell cycle events, Apoptosis, extracellular control of cell growth and apoptosis. Cell Junctions and cell adhesion: Anchoring, adherence junctions, Desmosomes, gap junctions, cohesion. Extracellular signal molecules, nitric oxide gas signal.

(Teaching 22 hrs)

Bacterial photosynthesis and Biological oxidation: Photosynthetic microorganisms, photosynthetic pigments, Bacterial photosynthesis - electron transport chain, cyclic and non-cyclic photophosphorylation. Carbon assimilation in microbes. Free energy changes and electron transport. Aerobic respiration – EMP pathway & Kreb's cycle and oxidative phosphorylation (ETS, Proton pump ATP synthesis) &. Inhibition of electron transport chain. Bacterial anaerobic respiration and HMP & ED. **(Teaching 24 hrs)**

Bacterial chemolithotrophy: Physiological groups of chemolithotrophs, ammonia oxidation by members of Genus nitroso group, nitrite oxidation by nitro group of genera. Oxidation of molecular hydrogen by *Hydrogenomonas* species. Ferrous and sulfur/sulfide oxidation by *Thiobacillus* species. **(Teaching 18 hrs)**

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TEXTBOOKS:

1. Molecular Biology of the Cell – Albert, Johnson, Lewis, Raff, Roberts and Walter.
2. Molecular Cell Biology. Lodish, Birk, and Zipursky. Freeman.
3. Microbial Physiology by Albert G. Moat and John W. Foster.Third edition, John Wiley and Sons.

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SESSION 2023-2024

M. Sc. THIRD SEMESTER
MICROBIOLOGY

PAPER – IV

CCMB-304 (Enzymology and Biochemical techniques)

----------Max. Marks – 80------

Basic concepts of enzymes: Nomenclature, classification, methods for determination of enzyme activity. Isolation and purification of enzymes. Enzyme kinetics: Michaelis- Menten Equation, Lineweaver Burk plot, Eadie Hofstee plot. Effect of pH, substrate concentration, temperature and inhibitors. Isoenzymes and allosteric enzymes. Enzyme inhibition- competitive and non-competitive inhibition. **(Teaching 20 hrs)**

Mechanism of enzyme action: Action of Ribonuclease, chymotrypsin, and trypsin. Coenzyme catalysis. Mechanism of action of thiamine pyrophosphate enzyme. Control and regulation of enzyme activity and feedback mechanisms. Metabolic compartmentalization in relation to enzyme. **(Teaching 20 hrs)**

Enzyme engineering & applications of microbial enzymes: Chemical modification and site-directed mutagenesis structure & function relationship of industrially important enzymes. Microbial enzymes in textile, leather, wood industries and detergents. Enzyme sensors for clinical processes and environmental analysis. Enzymes as therapeutic agents. **(Teaching 20 hrs)**

Biochemical techniques: Determination of molecular weights, purity, length and volume of organic compounds. Extraction, purification, application and analysis of proteins, carbohydrates and lipids. General methods of extraction - salting out, use of organic solvents; Purification; mass determination- GC, MS, MALDI-TOF; structure determination- X-ray diffraction. Methods of analysis: Proteins, carbohydrates, lipids, other organic compounds. DNA analysis- Southern blotting, Northern blotting, Western blotting. **(Teaching 20 hrs)**

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TEXT BOOKS:

1. Biochemistry by Lehninger
2. Principles of Biochemistry and molecular biology: Wilson & Walker
3. Biochemistry of Nucleic acids by Davidson

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SESSION 2023-2024

M.Sc. THIRD SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-I
(CCMB-301 &CCMB-302)

SECTION-A

1. Determination of blood groups and Rh typing.
2. Widal [slide] test for typhoid by antigen-antibody reaction.
3. Pregnancy testing through commercially available method.
4. Rheumatoid arthritis test [RA] by antigen and antibody reaction.
5. RPR [rapid plasma reagin] test for syphilis
6. Detection of specific antigen by using ELISA technique.
7. Separation and characterization of lymphocytes from blood and demonstration of lymphocyte population.
8. Study of antigen and antibody reaction by immunodiffusion technique

SECTION-B

1. Different Staining Techniques: Acid fast staining, Giemsa staining and Leishman staining.
2. Special staining methods to demonstrate granules, capsule and spores.
3. Isolation of pathogens from clinical samples: pus, blood and urine.
4. Isolation and identification of following pathogenic bacteria, fungi

   Bacteria: *Staphylococcus aureus; Escherichia coli, Proteus vulgaris; Proteus mirabilis, Salmonella typhi; Salmonella paratyphi; Shigella dysentriae; Shigella flexneri.*

   Fungi: Candida albicans; Microsporum, Trichophyton.
5. Antibiotic sensitivity testing by disc diffusion method.

Scheme of examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

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SESSION 2023-2024

M.Sc. THIRD SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-II
(CCMB-303 &CCMB-304)

Section A

1. Preparation of mitotic plate by carmine squashing method and phase identification.
2. Preparation of Karyotype of metaphase plate.
3. Preparation of Meiotic plate and determination of phases.
4. Computation of Chiasma frequency and Terminalization of phases
5. Micrometry and Camera Lucida drawings

Section B

1. Isolation and cultivation of autotrophic microbes.
2. To study the effect of salt concentration on bacterial growth by turbidometry method.
3. Determination of thermal death point (TDP) of an organism.

Section C

1. Determination of kinetic constant of amylase:-Amylase activity, Vmax. Km.
2. Effect of pH and temperature on amylase activity.
3. Effect of inhibitors on amylase activity.
4. UV absorption of proteins, DNA and RNA.

Scheme of examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

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SESSION 2023-2024

SCHEME OF COURSE CURRICULUM

M. Sc. Fourth Semester

MICROBIOLOGY

Paper	Paper code	Title	Marks
First	CCMB- 401	Industrial Microbiology	80
Second	CCMB- 402	Agriculture Microbiology	80

PRACTICAL PAPER

First:		100
Internal Assessment:		
Test of each Paper for 10 marks:	10×2=	20
Seminar of each Paper for 10 marks:	10×2=	20
Project work:		
Thesis (based on original research work)		200
Presentation & Viva		100
Total		600

Syllabus in detail, as above has been enclosed herewith and is being recommended hereby-

***Internal test:** Two tests shall be taken, as prescribed question pattern and average marks of both tests shall be considered.*

*** **Question Papers:** It shall be comprise two sections – A and B. Section A – Question no. 1 shall consist 10 objective questions of 10 marks (one mark for each) and Question no. 2 shall be consist 05 short answer type questions of 10 marks (two mark for each); all questions are compulsory. Section B shall be consist 08 descriptive type questions out of which any four shall have to solve, each question carrying equal (15) marks. Each type of question shall cover the entire syllabus.*

Name and Signature of Convener & members of B.O.S:

Dr. D. K. Shrivastava
Prof. In-charge, Dept. of Microbiolog

SESSION 2023-2024
M.Sc. FOURTH SEMESTER
MICROBIOLOGY

PAPER – I
CCMB-401 (Industrial Microbiology)

----------Max. Marks – 80------

Industrial strains: Industrially important microorganisms, sources and characters; Strategies for selection, Primary and secondary screening, strain improvement, preservation of industrially important strains & maintenance. Downstream processing: recovery and purification of fermentations products (intracellular and extracellular), cell disruption, precipitation, filtration, centrifugation, solvent recovery, chromatography, Ultrafiltration and drying, Quality assurance (QC) of finished product. Immobilization of cell and enzymes. **(Teaching 18 hrs)**

Microbial growth kinetics: Microbial growth, generation time, Equation for growth. Batch, fed batch, continuous fermentation. Batch kinetics – Monod's model (single substrate), deviations from Monod's multiple Substrates–simultaneous utilization, substrate inhibition, toxic inhibition. Fed-batch kinetics – fixed volume, variable volume and cyclic fed-batch and its applications with examples. Continuous cultivation system. **(Teaching 22 hrs)**

Metabolic pathways: Industrial production of citric acid, acetic acid, Lactic acid, Glutamic acid, Single cell protein. Production of bio fertilizers, bio pesticides, Hepatitis vaccine, Rabies vaccine, insulin. Fermented food and beverages. **(Teaching 18 hrs)**

Industrial fermentation products: Bio-fuels – Ethanol & Methane, Biohydrogen. Antibiotics - β-lactam antibiotics (Synthetic penicillin and cephalosporin), Streptomycin and chloramphenicol. Bio-preservative - *Lactobacillus sakei.* Biopolymers: Xanthan, Polyhydroxyalkanotes. Thermostable enzymes: - Proteases. **(Teaching 22 hrs)**

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TEXT BOOKS:

1. Biotechnological innovations in chemical synthesis. BIOTOL Publisher.
2. Industrial microbiology, G. Reed, CBS Publishers.
3. Biology of Industrial microorganisms. A. L. Demain.
4. Stanbury P. F. A. Whitaker and Hall. Principles of fermentation technology.
5. Fermentation: A practical approach. IRL

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SESSION 2023-2024

M.Sc. FOURTH SEMESTER

MICROBIOLOGY

PAPER – II

CCMB-402 (Agriculture Microbiology)

----------Max. Marks – 80------

Soil microbiology: Soil - types, profile, physic-chemical characteristics and its suitability for agriculture. Soil- enzymes and its significance. Inter-relationship of soil & microorganisms and its effect; fate of microbes introduced into soil and their establishment. Factors (biotic & abiotic) influencing bacterial survival in soils. Rhizosphere and rhizoplane micro flora. **(Teaching 20 hrs)**

Biology of beneficiary microorganisms to plants: Nitrogen fixation- principle and mechanism; Nitrogen fixing microbes – Free living N2 fixing bacteria and cyanobacteria (heterocystous strains), symbiotic N2- fixers; Azolla and Frankia. Mycorrhiza – ectomycorrhiza and endomycorrhiza. VAM structure and significance. Biochemistry and Genetics of nitrogen fixation with reference to free living and symbiotic nitrogen fixers viz. *Azotobacter vinelandii* and Rhizobium. Significance of *nif H, D, K, A, L, nod, nodulin and fix* genes in the process of microbial nitrogen fixation. **(Teaching 20 hrs)**

Biocontrol agents for agriculturally important crop plants: Bacterial and fungal pathogens of crop plants and their symptoms. Disease control- biological, Chemical. Antisense RNA technology. Microbial pesticides- production and their significance. Source of biopesticides: Bacteria-*Bacillus thuringiensis* and other Bacilli producing pesticides; Fungi—*Beauveria bassiana* and *Trichoderma;* Viruses- *Baculoviruses*. Phosphate mobilization. **(Teaching 20 hrs)**

Pathogenesis in plants and defense response: Virulence in plant pathogens: biochemical and genetic basis of virulence. Toxins as virulence factors. Phytoalexins and their induction. Plant defense responses or mechanisms of control (anatomical changes and biochemical synthesis of toxins, alkaloids. **(Teaching 20 hrs)**

TEXT BOOKS:

1. Soil Microbiology by Martin Alexander
2. Agricultural Microbiology Biotechnological approaches in soil microorganisms for Sustainable crop production by Dadarwal 1997
3. Agricultural Microbiology by N.S. Subba Rao
4. Biology of Nitrogen fixing Cyanobacteria by N.G. Carr and B. A.Whitton
5. Fundamentals of Agricultural Microbiology by K. C. Mahanta
6. Applied Soil Biology and Ecology by G. K. Veeresh and D. Rajagopal

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SESSION 2023-2024

M. Sc. FOURTH SEMESTER
MICROBIOLOGY

PRACTICAL PAPER-I
(CCMB-401 &CCMB-402)

Section-A

1. Microbial analysis of food products – bacterial and fungal
2. Isolation and preliminary identification of microorganisms from different spoiled fruit and vegetables.
3. Determination of milk quality by standard plate count.
4. Determination of quality of milk sample by methylene blue reduction test and phosphatase test.
5. Isolation of microbes from yoghurt, curd.
6. Demonstration of wine production by using grape juice.

Section -B

7. Production of ammonia from organic compounds (Ammonification).
8. Bioconversion of ammonia to nitrate (nitrification).
9. Determination of nitrate production.
10. Characterization of different soils for detection of various microbial enzymes; amylase, lipase, protease and catalase.
11. Morphological characterization of cyanobacteria, separation and determination of cyanobacterial pigments

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Scheme of examination:

Lab performances	60 marks	
Spotting	20 marks	
Oral evaluation	10 marks	
Sessional	10 marks	
Total	100 marks	Provided period- 06 hrs

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SESSION 2023-2024

M. Sc. FOURTH SEMESTER
MICROBIOLOGY

PROJECT WORK

Duration: 03 months **MM: 300**

GUIDE LINE FOR PROJECT WORK

To promote the research activity among the students of postgraduate course for prosperous carrier in the field of microbiology, a scheme of project work has been included in syllabus comprising following features and conditions

1. The project work will be completed within three months- first half of the semester.

2. The project work will carry total 300 marks, out of which 200 marks will be attributed to entire research work, would be evaluated in the form of thesis- compiled printed matter of research work performed by the students. Remaining 100 marks will be credited on the oral presentation of the research work as viva- voce examination.

3. To complete the research work under this scheme, a list of consented research centers / research scientist / research workers will be provided to the students.

4. Choice based centers / scientists /research workers will have to be selected by the students. under the condition not more than three students will be opted at single centre / institution.

5. Determination of project work, project period and official activities will be performed by the department, however the expenditure concerned during research work will be the liability of the students.

6. After completion of work the thesis as a report of project work will be submitted to the autonomous cell with certificate of principal, Head of department and Research guide for proper evaluation and consideration.

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Rashmi