PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR M. SC. MICROBIOLOGY Scheme of Examination					
July 2014 – December 2014					
	Paper No.	Title of Paper	Marks		Credit
			(External)	(Internal)**	
FIRST Semester	I*	Cell Biology	80	20	4
	II	Biomolecules and Enzymology	80	20	4
	III	Microbiology	80	20	4
	IV	Biology of Immune System	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
		Total	600		
January 2015 – June 2015					
	Paper No.	Title of Paper	Marks		
			(External)	(Internal)	
SECOND Semester	I	Molecular Biology	80	20	4
	II	Bioenergetics & Metabolism	80	20	4
	III	Instrumentation	80	20	4
	IV	Biostatistics and Computer Applications	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
		Total	600		
July 2015 – December 2015					
	Paper No.	Title of Paper	Marks		
			(External)	(Internal)	
THIRD Semester	I	Microbial Physiology	80	20	4
	II	Fermentation Technology	80	20	4
	III	Environmental Microbiology	80	20	4
	IV	Medical Microbiology - I	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
		Total	600		
January 2016 – June 2016					
	Paper No.	Title of Paper	(External)	(Internal)	
FOURTH Semester	I	Microbial Biotechnology	80	20	4
	II	Medical Microbiology - II	80	20	4
	III	Food Microbiology	80	20	4
	IV	Agricultural Microbiology	80	20	4
	LC-I	Lab Course I (Based on paper I & II)	80	20	2
	LC-II	Lab Course II (Based on paper III & IV)	80	20	2
		Total	600		
	OR				
		Project Work* **			
		Dissertation	240	60	11
		Seminar based on project	160	40	06
		Viva-voce	80	20	03
		Total	600		
		Grand Total	**2400**		

* Each theory paper will have **5 questions** of equal marks. First question (Multiple choice type or short answer type) will be based on all units (complete syllabus) with no internal choice, whereas remaining

questions will be unit wise having internal choice within each unit.

** Each student will be evaluated continuously throughout the semester. There will be a class test based on each theory paper. The full marks will be 10 for each paper. There will be a poster/oral presentation based on each theory paper. The full marks will be 10 for each presentation. Each student will be required to submit a brief write-up (not more than 10 pages) on his/her poster/oral presentation.

***A student of IV semester will have the choice to opt for project work in lieu of four theory papers and two lab courses provided he/she secures at least 75% or more marks in aggregate in semester I and II. The project has to be carried out in recognized national laboratories or UGC recognized universities. No student will be allowed to carry out project work in private laboratories/ college/ institutions, excluding the colleges recognized as research centers by the RDC of Pt. Ravishankar Shukla University, Raipur. The valuation of all the projects will be carried out by an external examiner and HoD of UTD or its nominee at the UTD Centre.

Scheme for Lab Course (for each Semester)	**Maximum Mark 100**	
1	Major Exercise based on paper 1	20
2	Minor Exercise based on paper 1	10
3	Major Exercise based on paper 2	20
4	Minor Exercise based on paper 2	10
5	Spotting/ Interpretation****	10
6	*Viva- voce*	10
	Sub Total	80
	Sessional (Internal)	20
	Total	100

****A student will be required to interpret on the displayed item/material

M. Sc. Microbiology

FIRST SEMESTER

(July 2014 – December 2014)

PAPER I: CELL BIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

Molecular organization of membranes- asymmetrical organization of lipids, proteins and carbohydrates. Transport of small molecules across membranes: types and mechanism. Active transport by ATP-powered pumps: types, properties and mechanisms. Transport of proteins into mitochondria and chloroplast.

UNIT II

Transport of proteins into and out of nucleus. Transport of proteins into endoplasmic reticulum. Transport by vesicle formation: endocytosis and exocytosis. Molecular mechanism of vesicular transport.

UNIT III

Cell signaling: Signaling via G-protein linked and enzyme linked cell surface. Receptors, MAP kinase pathways, interaction and regulation of signaling pathways. Eukaryotic cell division cycle: different phases and molecular events. Cell cycle and apoptosis: control mechanisms: role of cyclins and cyclin dependent kinases, retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death. Oncogenes and tumor suppressor genes: viral and cellular Oncogenes, tumor suppressor genes from humans, structure, function and action of pRB, and p53 tumor suppressor proteins.

UNIT IV

DNA content, banding pattern, C–value complexity, C-value paradox, euchromatin & heterochromatin. Structure of centromere, nucleolar organizer and telomere. Structure of nucleosomes, DNA, histone interaction, histones and non-histones, DNA packaging, 10 nm fibril, 30nm fibril, solenoid structure. Classes of DNA, reassociation kinetics, Cot curve, Rot curve analysis

Lab Course:

1. Mitosis and meiosis (Onion root tip, human lymphocytes)
2. Chromosome Preparation (*Allium cepa*,/ rat testis /grass hopper testis)
3. Polytene chromosome
4. Estimation of DNA
5. Estimation of RNA
6. Sub-cellular fractionation and marker enzymes
7. Identification of biomolecules in tissues by histochemical techniques

Books Recommended:

H Lodish *et al.* Molecular Cell Biology
B Alberts *et al*. Essential Cell Biology
H Lodish *et al.* Molecular Cell Biology
B Alberts *et al*. Molecular Biology of the Cell
G Karp Cell and Molecular Biology: Concepts and Experiments

M. Sc. Microbiology

FIRST SEMESTER

(July 2014 – December 2014)

PAPER II: BIOMOLECULES AND ENZYMOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

Carbohydrates: structure, classification, properties and function; derivatives of monosaccharides, homo and hetero-polysaccharides, Peptidoglycan, glycoproteins and liposaccharide. Lipids: Classification, structure and function. Nucleic Acid: Structure of purine and pyrimidine bases, nucleoside and nucleotide; DNA-structure and conformation; RNA - Structure, types and functions.

UNIT II

Amino acids: structure, classification and functions; Synthesis of peptides and protein sequencing. Proteins- properties, covalent structure; secondary, tertiary and quaternary structure of proteins, Ramchandran plot

UNIT III

Enzyme classification, coenzymes, active site of enzyme, factors contributing to the catalytic efficiency of enzyme; enzyme kinetics- Michaelis-Menten equation, determination of Km, enzyme inhibition, allosteric enzymes, isoenzymes, ribozyme, multienzyme complexes

UNIT IV

Chemistry of porphyrins: Importance of porphyrins in biology; structure of hemoglobin and chlorophyll porphyrins, structure and biological role of animal hormones, structure and biological role of water soluble and fat soluble vitamins.

Lab Course:

1. Specific tests for sugars, amino acids and lipids
2. Formal titration of amino acids
3. Estimation of proteins using ninhydrin and biuret method
4. Estimation of sugar by anthrone and Folin-Wu method.
5. Saponification value and iodine number of fat.
6. Estimation of ascorbic acid.
7. Achromic point determination using salivary amylase
8. Effect of ions on salivary amylase activity.
9. Enzyme assay and kinetics (ex. Amylase, Protease)

Books Recommended:

- Principles of Biochemistry by Nelson, Cox and Lehninger
- Biochemistry by G. Zubay
- Biochemistry by Stryer
- Biochemistry by Garrett and Grosham
- Text book of biochemistry by West, Tood, Mason & Bbruglen
- Biochemistry by White, Handler & Smith
- Biochemistry by D. Voet and J C Voet

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FIRST SEMESTER

(July 2014 – December 2014)

PAPER III: MICROBIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

General characteristics of fungi, classification of fungi, life cycle of selected fungal genus (Aspergillus, Pencillium, Fusarium and Mucor). Economic importance of fungi. Fungi and bioremediation, parasitism, mutualism and symbiosis with plants and animals. Heterothallism, sex hormone in fungi, Mycorrhiza, VAM. Algae: Distribution, classification, reproduction, ecology and importance.

UNIT II

Morphology and ultra structure of bacteria, morphological types, cell wall of archaebacteria, gram negative, gram positive eubacteria, eukaryotes.

Cell membranes – structure, composition and properties. Structure and function of flagella, cilia, pili, gas vesicles. Cyanobacteria, protozoa, mycoplasma and Rickettsia.

Gene transfer mechanisms, transformation, transduction, conjugation and transfection. Plasmids F: factors colicins and col factors, plasmids as a vector for gene cloning.

UNIT III

Nutritional types (autotrophs, heterotrophs, phototrophs, chemotrophs), growth curves, measurement of growth, factors affecting growth, generation time, growth kinetics. Batch and continuous culture, asynchronous and synchronous culture.

Basis of microbial classification, classification and salient feature of bacteria according to Bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles.

UNIT IV

Viruses: Structure and classification of viruses; morphology and ultra structure; capsids and their arrangements, types of envelopes, viral genome, their types and structure, virus related agents (viroids, prions). General feature of virus reproductions, early events in virus multiplication, virus restriction and modification of host, virus mRNA. General overview of bacterial viruses, RNA and DNA bacteriophages (MS2, ϕX174, M13, T3, T4). Lysogeny and Lytic phase. General account of plant and animal viruses (TMV, HIV and other oncogenic virus, Hepatitis virus).

Lab Course:

1. Glassware preparation and sterilization techniques- wet heat- dry heat- filter types- laminar flow chamber types- CDC- safety levels.
2. Preparation of liquid & solid media, plating, pouring, inoculation and incubation for growth of microorganism
3. Methods of obtaining pure culture of microorganisms (a) streak plate (b) Pour plate, and (c) spread plate methods
4. Microscopic examination of the microorganisms, identification and staining methods
5. Micrometry and camera lucida drawings
6. Study of bacterial growth by turbiditimetry/ spectrophotometry
7. Biomass measurement for fungi
8. Isolation and enumeration of microorganisms from soil by serial dilution agar plating method.
9. Enumeration of viruses by plaque assay technique.
10. Motility of bacteria by hanging drop technique.

Books Recommended:

- Microbiology: L.M. Prescott, J.P. Harley and D.A. Klein, McGraw Hill Publication.
- General Microbiology: Stanier, Ingrahamana, Wheelis and Painter, Mac Millian Press
- Principles of Microbiology: R.M. Atlas
- Microbiology: Peleczar, Chan & Krieg
- General Virology: Luria, Darnell, Baltimore and Campell
- Introduction to Mycology: CJ Alexopoulos and CW Mims, Wiley Eastern Ltd, New Delhi

M. Sc. Microbiology

FIRST SEMESTER

(July 2014 – December 2014)

PAPER IV: BIOLOGY OF IMMUNE SYSTEM

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

Innate immune mechanism and characteristics of adaptive immune response. Cells of immune system: Hematopoisis and differentiation, mononuclear cells and granulocytes. Antigen presenting cells. Primary and Secondary lymphoid organs and tissues. Ontogeny and phylogeny of lymphocytes. Lymphocyte traffic.

UNIT II

Antigen receptor molecules: B-cell receptor complex, Immunoglobulin- structure, types and function. T-cell receptor complex. Major Histocompatibility Complex- types, structural organization, function and distribution. Transplantation and Rejection. Complements in immune function.

UNIT III

Antigens: nature of antigens, factor affecting immunogenicity, Haptens and super antigens. Antigenic determinants. Recognition of antigens by T and B cell. Antigen processing. Role of MHC molecules in antigen presentation and co-stimulatory signals. Antigen and antibody interaction.

UNIT IV

Cell mediated immune response. Cytokines and interleukins- structure and function. Immunity to infections. Hypersensitive reactions and their types. Immunodeficiency disorders. Autoimmunity

Lab Course:

1. Identification of cells of immune system
2. Separation of mononuclear cells by Ficoll-Hypaque
3. Identification of Lymphocytes and their subsets
4. Lymphoid organs and their microscopic organization
5. Isolation and purification of Antigens
6. Purification of IgG from serum
7. Estimation of Levels of gamma globulins and A/G ratio in blood
8. Antigen antibody interaction

Books Recommended:

- Kuby's Immunology: R.A. Goldsby, Thomas J Kindt and Barbara A. Osborne
- Immunology- A short Course: E. Benjamini, R. Coico and G. Sunshine
- Immunology: Roitt, Brostoff and Male
- Fundamentals of Immunology: William Paul
- Immunology: Tizard
- Immunology: Abbas *et al*

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SECOND SEMESTER

(January 2015 – June 2015)

PAPER I: MOLECULAR BIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT – I: DNA and Chromosomes

Structure and function of DNA: Packaging of DNA into a set of eukaryotic chromosomes. Chromosomes contain a long string of genes, Organization of genes in chromosomes, Conserved and non-conserved regions of DNA sequence, States of chromosomes during cell cycle. Centromere, telomere and replication origin sequences of DNA in chromosomes.

Packaging of DNA into chromosomes: Structure of nucleosomes, packaging of nucleosomes in chromatin fibers, ATP-driven chromatin remodeling, modification of histone tails.

Structure of chromosomes: Structure of Lampbrush and Polytene chromosomes, Heterochromatin and euchromatin, Heterochromatin at the end of chromosomes and centromeres, role of heterochromatin, mitotic chromosome, banding pattern of chromosomes, territories of chromosomes in interphase nucleus.

DNA Replication: DNA template, DNA polymerases, Leading and lagging strands, DNA helicase, DNA primase, primosome, clamp protein, proteins at replication fork, DNA topoisomerases, replication origin in bacteria and yeast, replication at different regions on eukaryotic chromosomes, origin of replication in humans, assembly of nucleosomes behind replication fork, telomere replication, telomerase, telomere length.

UNIT – II: Mutation, Recombination, Transposons and DNA Repair

Mutation: Mutation, Molecular basis of spontaneous and induced mutations, Intragenic suppression and intergenic suppression, Ames test.

Recombination: Copy– choice hypothesis, breakage and reunion hypothesis, Homologous recombination, Holliday model, RecA protein, gene conversion.

Transposons and retropoviruses: Insertion sequences, composite transoposons, replicative and non-replicative mechanisms of transposition, controlling elements in maize. Life cycle of retrovirus, retroviral gens, reverse transcription, DNA integration.
DNA repair: Photo-reactivation, Strand-directed mismatch repair, Base excision repair, Nucleotide excision repair, Error-prone repair, Replication repair, Inherited syndromes with defects in DNA repair.

UNIT – III: DNA to RNA to Protein
Transcription: Types of RNA, RNA polymerases, Start and stop signals, RNA polymerases in eukaryotes, RNA polymerase II and its transcription factors, Activator, mediator and chromatin modifying proteins, transcriptional elongation.
RNA splicing: Spliceosome, RNA splicing mechanisms, trans-splicing, self-splicing mechanisms.
Translation: Genetic code, aminoacyl – tRNA synthetase, initiator tRNA, eukaryotic initiation factors, stop codons, elongation factors, molecular chaperons.

UNIT – IV: Control of gene expression:
Introduction: Different cell types of multicellular organisms contain same DNA, Different cell types synthesize different sets of proteins, cell can change gene expression in response to external signals, Points of gene control in pathway from DNA to RNA to protein.
Basic components of gene regulatory switches: Gene regulatory proteins and specific sequences, short DNA sequences are fundamental components of genetic switches, gene regulatory proteins contain structural motifs that can read DNA sequences, Helix-turn-helix motifs, Zinc finger motif, Leucine-zipper motifs, helix-loop-helix motif.
Regulation of transcription in prokaryotes: Tryptophan operon, *lac*-operon.
Regulation of transcription in eukaryotic cells: Gene regulatory proteins control gene expression from a distance, control region consists of promoter plus regulatory DNA sequences, gene activator proteins promote assembly of RNA polymerase and general transcription factors at start point of transcription, gene activator proteins modify local chromatin structure, Insulator DNA sequences prevent gene regulatory protein from influencing distal genes, control of cell types in yeast, role of cro and repressor proteins in bacteriophage lambda. RNA editing, RNA interference.

Lab Course:

1. Isolation, purification and estimation of RNA
2. Isolation, purification and estimation of DNA
3. Determination of Tm of nucleic acid
4. Fraction of poly (A) RNA

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SECOND SEMESTER

(January 2015 – June 2015)

PAPER II: BIOENERGETICS AND METABOLISM

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

First and second laws of thermodynamics. Concept of free energy, High – energy compounds, ATP cycle, structural basis of free energy change during hydrolysis of ATP. Other high – energy biological compounds

UNIT II

Basic concepts of intermediary metabolism. Carbohydrate metabolism: Glycolysis, Kreb's cycle, glycogenolysis, glycogenesis, pentose phosphate pathway, gluconeo- genesis, and glyoxylate pathway,

inborn errors of carbohydrate metabolism. Regulation of carbohydrate metabolism.

UNIT III

Electron transport and oxidation phosphorylation: electron carriers, Complexes I to IV, substrate level phosphorylation, mechanism of oxidative phosphorylation, Shuttle system for entry of electron, Biosynthesis and degradation of Lipids, Regulation of lipid metabolism.

UNIT IV

Nitrogen Assimilation. Biosynthesis of amino acids. Degradation of amino acids. Regulation of amino acid metabolism. Biosynthesis and degradation of purine and pyrimidine nucleotides.

Lab Course:

1. Protein estimation by Lowry, Bradford and Spectrophotometric method
2. Estimation blood cholesterol
3. Estimation of sugar by Nelson- Somagy and Benedict's reagent
4. Isolation and estimation of lipid from seeds and egg.
5. Estimation of inorganic and total phosphorus by Fiske-Subba Rao method
6. Assay of phosphatases in blood and seeds
7. Urease estimation in plant tissues

Books Recommended:

- Principles of Biochemistry by Nelson, Cox and Lehninger
- Biochemistry by G. Zubay
- Biochemistry by Stryer
- Biochemistry by Garrett and Grosham
- Text book of Biochemistry by West, Tood, Mason & Bbruglen
- Biochemistry by White, Handler & Smith
- Biochemistry by with clinical application
- Biochemistry by D Voet and J C Voet
- Enzymes by Dixon and Webb
- Fundamentals of Enzymology by Price and Steven
- Practical Biochemistry by Plummer
- Enzyme Biotechnology by G. Tripathi
- Enzyme Reaction Mechanism by Walsh.
- Enzyme Catalysis and Regulation by Hammes

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SECOND SEMESTER

(January 2015 – June 2015)

PAPER III: INSTRUMENTATION

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

Centrifugation: Principle, techniques. Preparative, analytical and ultracentrifuges, sedimentation coefficient and factors affecting sedimentation coefficient. Application of centrifugation.
Photometry: Basic principles of colorimetry, UV- visible spectrophotometry & IR- spectrophotometry. Spectroflurometry
Atomic absorption spectroscopy: Principle, Instrumentation and applications.

UNIT II

Theory, principle and applications of Paper and Thin Layer Chromatography.
Gel filtration, Ion exchange and Affinity chromatography.
Gas-liquid chromatography and HPLC.
Microtomy: types, principle and applications.
Microscopy: light, phase-contrast, fluorescence and electron microscopy.

UNIT III

Electrophoresis, Moving boundary and Zonal.
Paper electrophoresis, Starch gel, agarose, PAGE-type, 2D-E.
Isoelectric focusing and isotachophoresis.
Lyophilization: Principle, instrumentation and applications.

UNIT IV

ORD and CD: Principles, instrumentation and applications.
NMR, GC-Mass: Principles, instrumentation and applications.
Radioactivity: GM counter, liquid Scintillation counter, solid Scintillation counter, gamma counters.
RIA and Autoradiography: applications.

Lab Course:

1. Verification of Beers Law
2. Determination of absorption maxima
3. Quantitative determination, Enzyme kinetics
4. Amino acid and carbohydrate separation by paper and TLC
5. Ion exchange and gel filtration chromatography
6. SDS Polyacralamide Gel Electrophoresis
7. Isoenzymes
8. Separation of sub-cellular organelles by differential centrifugation

Books Recommended:

- Instrumental Methods of Analysis by B.K. Sharma
- Instrumentation by Chatwal & Chatwal
- Instrumentation by Upadhyaya & Upadhyaya

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SECOND SEMESTER

(January 2015 – June 2015)

PAPER – IV: BIOSTATISTICS & COMPUTER APPLICATIONS

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT I

Introduction to biostatistics. Types of biological data: data on different scales. Frequency distributions. Cumulative frequency distributions. Random sampling. Parameters and statistics. Measures of central tendency and dispersion: Mean, Median, Mode, Range, Variance and Standard deviation. Coefficient of variation. The effects of coding data. Data transformations: Log-transformation, Square-root transformation and Arcsine transformation. Distribution: normal and binomial. Probability: Basic laws of probability, addition law, multiplication law. Probability and frequency.

UNIT II

Statistical errors in hypothesis testing. Testing goodness of fit: Chi-square goodness of fit. Heterogeneity Chi-square. The 2 x 2 contingency table. One sample hypothesis. Two- sample hypothesis. Testing for difference between two means (*t*-test). Testing for difference between two variances (*F*-test). The paired sample *t*-test. Multiple-sample hypothesis (ANOVA): Single factor and two factors ANOVA. Multiple comparisons: Duncan's multiple-range tests. Simple linear regression. Regression *vs.* Correlation. Regression equation. Interpretations of regression functions. Simple linear correlation. The correlation coefficient.

UNIT III

Introduction to MS-Office software: Word processing; Creating new document, Editing documents, Adding graphics to documents, Word tables. Management of Workbook & Worksheets; Applications, Features, Using formulas and functions, Features for Statistical data analysis, Generating charts/ graph. Presentation software; Working in PowerPoint, Creating new presentation, Working with slides.

UNIT IV

Introduction to Internet and Applications. Basics of internet, e-mailing, Search engine - Google, Yahoo, MSN, Entrez including Pubmed, Web of Science, Citation Index: Science Citation Index (SCI), h-index, i-10-index. Journal Impact Factor (JIF). Introduction to Plagiarism and Cyber laws.

Lab Course:

1. Exercises for data distribution
2. Exercises for computation of measures of central tendency
3. Exercises for computation of measures of variability
4. Computation of correlation coefficient, r, and regression constants
5. Data analysis by ANOVA and multiple-range tests
6. Hypothesis testing by *t*-test, F-test, and Chi-square test
7. Graphical presentation of data using a suitable package
8. Statistical analysis of a data using a suitable package
9. Preparation of document using a suitable package
10. Preparation of slides using a suitable package

Books Recommended:

Campbell RC	Statistics for biologists
Zar JH	Biostatistical Analysis
Wardlaw AC	Practical Statistics for Experimental Biologists
Snedecor GW & Cochran WG	Statistical Methods
Sokal RR & Rohlf FJ	Introduction to Biostatistics
Sumner M	Computers: Concepts & Uses
White R	How Computers Work
Cassel P *et al.*	Inside Microsoft Office Professional
Coleman P and Dyson P	Mastering Internets
Gralla P	How the Internet Works
Shelly GB, Vermaat ME, Cashman TJ	Microsoft 2007: Introductory Concepts and Techniques
Habraken J	Microsoft Office 2003 All in One Microsoft Office 2010 In Depth
Gilmore B	Plagiarism: Why it happens, How to prevent it?
Buranen L and Roy AM	Perspectives on Plagiarism and Intellectual Property in a Post-Modern World
Kumar Anupa P	Cyber Law
Sood V	Cyber Law Simplified

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THIRD SEMESTER

(July 2015 – December 2015)

PAPER I: MICROBIAL PHYSIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Aerobic metabolism of methane and methanol: Methane and methanol users, Oxidation of methane, Formaldehyde and formic acid, assimilation of C-1 compounds.
Anaerobic respiration: Sulphur compounds and nitrate as electron acceptors, electron transport in SO_4 and NO_3 reducers. Anaerobic metabolism of glucose, Fermentation process, modes of glucose fermentation (lactic acid, ethanol, acetic acid, butyric acid, acetone and butanol, formate and propionate). Transport of nutrients across membrane.

UNIT - II

Biosynthesis of peptidoglycan, teichoic acid, lipopolysaccharide, biosynthesis and degradation of essential amino acids, microbial degradation of aromatic, polycyclic and halogenated aromatic compounds. Microbial metabolism of hydrogen.

UNIT - III

Microbial photosynthesis: Historical account, structure of photosynthetic pigments i.e., chlorophylls and bacterio-chlorophylls, carotenoids, phycobilins, primary photochemistry and electron transport (light harvesting, charge-separation and electron transport in anoxygenic photosynthesis), ATP synthesis. Eubacterial photosynthetic microbes, development of photosynthetic apparatus, carbon metabolism. Cynobacterial organization of photosynthetic apparatus. Halobacterial photo-phosphorylation.

UNIT - IV

Nitrogen metabolism: Biological nitrogen fixation, Mechanism of nitrogen fixation, ammonia assimilation, properties and regulation of glutamine synthetase, glutamate synthetase, glutamate dehydrogenase. Biochemistry of methanogenesis; bio-transformation of steroid and non-steroid compounds.

Lab Course:

1. Qualitative of assay of different extra-cellular enzymes
2. Quantitative assay of alkaline and acid phosphatases from microorganisms.
3. Determination of Km value of beta- fructofuranosidase from yeast
4. Antibiotic sensitivity test
5. Measurement of CM-cellulase by viscometric and reducing sugar method.
6. Experiment on production of enzymes and optimizing parameters for enzyme production in shake flask culture using *Aspergillus niger*, *Saccharomyces cerevissae* for production of amylase, invertase respectively.
7. Experiment on production of citric acid and optimizing parameters for citric acid production in shake flask culture using *Aspergillus niger*.

Books Recommended:

1. Brown TA (1999) Genome. John Wiley & Sons (Asia) PTE. LTD.
2. Goeddel DV (1990) Methods in Enzymology, vol 185, Gene Expression Technology. Academic Press, San Diago.
3. Kaufman PB, Wu W, Kim D and Cseke LJ (1995) Molecular and Cellular Methods in Biology and Medicine. C. Press, Florida.
4. EL-Mansi E.M.T. and Bryce C.F.A. Fermentation Microbiology and Biotechnology. Taylor & Francis.

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THIRD SEMESTER

(July 2015 – December 2015)

PAPER-II: FERMENTATION TECHNOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

General Considerations: Fermentation biotechnology – An historical perspective, metabolic pathways and metabolic control mechanisms, primary and secondary metabolites, genetic regulation and catabolite repression, Fermentation kinetics, kinetics of substrate utilization, product formation.

UNIT - II

Types of bio-reactors, their design and instrumentation: Fed batch bio-reactors, continuous stirred tank bio-reactors, plug flow tubular reactors; multiphase reactors, packed bed, bubble column , fluidized bed and trickle bed bio-reactors, animal and plant cell bio-reactors, non-ideal mixing, batch and continuous sterilization, immobilized bio-catalysts, sensors for medium and gases.

UNIT - III

Industrial production of microbial biomass (SCP, and mushrooms), alcohol, organic acid (citric acid, gluconic acid, itaconic acid), amino acids (L- glutamic acid, L- lysine and L-aspartic acid), enzymes and antibiotics (Penicillin), microbial polysaccharides and polyesters.

UNIT - IV

Scale up, instrumentation control, Bio-sensors in bio-process monitoring and control. Downstream processing: Removal of microbial cells and solid matter, precipitation, filtration, centrifugation, disintegration of cells, extraction methods, concentration methods, purification and resolution of mixtures, drying and crystallization.

Lab Course:

1. Experiment on production of alcohol and optimizing parameters for alcohol production in shake flask culture using *Saccharomyces cerevissae.*
2. Experiment on production and optimizing parameters for SCP in shake flask culture.
3. Experiment on production of enzymes and optimizing parameters for enzyme production in solid-state fermentation using wheat bran and other agricultural solid waste.
4. Protein purification methods: affinity chromatography, ion exchange and gel filtration.
5. Recovery of products from solid state cultures -Recovery of intracellular products: Cell disruption procedures by sonication,
6. Carbohydrate catabolism by microorganisms (oxidation and fermentation of glucose)
7. Fermentation of carbohydrates.

Books Recommended:

- EL-Mansi E.M.T. and Bryce C.F.A. Fermentation Microbiology and Biotechnology. Taylor & Francis.
- Alberghina Lilia. Protein Engineering in Industrial Biotechnology. Harwood Academic Publishers.
- Jogdand S. N. Gene Biotechnology. Himalaya Publishing House.
- Olguin J. Eugenia, Sanchez Gloria & Hernandez Elizabeth. Environmental Biotechnology and Cleaner Bioprocesses. Taylor & Francis.
- Prescott & Dunn's. Industrial Microbiology. 4th ed, CBS publishers & Distributors.
- Bullock John and Kristiansen Bjorn. Basic Biotechnology. Academic Press.
- A.H. Patel. Industrial Microbiology

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THIRD SEMESTER

(July 2015 – December 2015)

PAPER III: ENVIRONMENTAL MICROBIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Distribution and ecology of microorganism: air spora- concepts and components, indoor and outdoor air spora, aeroallergens, Ecosystem- concept, components, food chains, food webs, and trophic levels. Energy transfer efficiencies between trophic levels. Environmental factors influencing the growth and survival of microorganism. Physical factors- temperature, light, osmotic pressure and hydrostatic pressure. Chemical factors- pH, O_2 and CO_2. Microorganisms of extreme environments: psychrophiles, mesophiles, thermophiles, acidophiles, alkalophiles, halophiles and specific habitats.

UNIT - II

Microbiology of water: aquatic ecosystems-types- fresh water (ponds, lakes, streams) - marine (estuaries, mangroves, deep sea, hydrothermal vent, saltpans, coral reefs). Zonation of water ecosystems– upwelling-eutrophication- food chain. Drinking and potable water, ecology of polluted water, microbiological treatment processes. Waste water disposal and reclamation. Brief account of major water borne diseases and their control measures.

UNIT – III

Soil microbiology: Micro flora of various soil types (bacteria and nematodes): rhizosphere- phyllosphere – brief account of microbial interactions symbiosis, mutualism, commensalism, competition, amensalism, synergism, parasitism, predation, biological N_2 fixing organisms, symbiotic fungi, Phosphate solubilizing organisms, Ecology of litter decomposition; extracellular enzymes (hydrolases), heterotrophic potential decomposers and utilizers relationship.

UNIT -IV

Biodegradation of cellulose lignins and hydrocarbons (superbug). Composting, treatment of solid wastes. Bioaccumulation of metals and detoxification-biopesticides; Biodeterioration: classification of biodeterioration of materials (monuments, paints, rubbers, plastics, fuels, lubricants, metals, stone, cosmetics, toiletries). Gmo and their impact.

Lab Course:

1. BOD & COD estimation in water sample
2. Study of microbial contaminants from water and wastewater.
3. Study of air borne microorganisms using various methods.
4. Assay of anti-fungal and antibacterial properties of agro-chemicals and fungicides.
5. Assessment of quality of oils using saponification value, iodine number, and free fatty acid composition.
6. Study of thermophilic microorganisms.
7. Bacteriological examination of water by multiple-tube fermentation test.
8. Determination of coliforms to determine water purity using membrane filter method.
9. Lipase production test.
10. Isolation of Rhizobium from root nodule.
11. Measurement of spore size using micrometry
12. Isolation of microorganisms from rhizosphere and phylloplane.

Books Recommended:

- Michael, T. Madican; John. M. Mmmartinko and Jack Parker. Brock. Biology of Microorganisms.
- Microbiology of Extreme Environments edited by Clive Edwards
- Olguin J. Eugenia, Sanchez Gloria & Hernandez Elizabeth. Environmental Biotechnology and Cleaner Bioprocesses. Taylor & Francis.
- Michel. R. Introduction to Environmental Microbiology. 1999

M. Sc. Microbiology

THIRD SEMESTER

(July 2015 – December 2015)

PAPER-IV: MEDICAL MICROBIOLOGY – I

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Normal microbial flora of human body, role of resident flora, host microbe interactions. Classification of medically important microorganisms. Infection and infectious process - routes of transmission of microbes in the body. Source of infection for man; vehicles or reservoirs of infection. Mode of spread of infection. Pathogenesis: Infectivity and virulence.

UNIT –II

Classification of pathogenic bacteria. *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium*, Non sporing Anaerobes, Organism belonging to Enterobacteriacea, vibrios, Non fermenting gram negative bacilli *Yersinia; haemophilus; Bordetelia; Brucella*; *Mycobacteria, Spirochaetes, Actinomycetes; Rikettsiae, Chlamdiae.*

UNIT- III

General properties of Viruses; Viruses Host Interactions, Pox viruses, Herpes viruses, Adeno viruses; Picarno viruses; Orthomyxo viruses; Paramyxo viruses; Arboviruses, Rhabdo viruses, Hepatitis viruses; Oncogenic viruses; Human Immuno deficiency viruses.

UNIT- IV

Mycology - Human mycotic infections caused by Dermatophytes, Histoplasma,
Cryptococcus, Candida, opportunistic mycoses. Mycotoxins. Description and classification of pathogenic fungi and their laboratory diagnosis.
Parasitology - Medical importance of Entamoeba, Giardia, Plasmodium, Taenia,
Ascaris, Wucherhiria. Laboratory techniques in parasitology.

Lab Course:

1. Identification of micro flora of mouth, skin and wounds.
2. Identification of enteric pathogens by TSIA medium.
3. IMVIC test.

Books Recommended:

- Prescott & Dunn's. Microbiology. CBS Publishers & Distributors.
- Anantnarayan R and Panikar CKJ: Text book of Microbiology, Orient Blackswan Pvt. Ltd.
- Broude AI: Medical Microbiology and Infectious Diseases, WB Saunders Co.
- Chapel and Haeney: Essentials of Clinical Immunology, Blackwell Scientific Publications
- Forbes BA, Sahm DF and Weissfeld AS: Bailey & Scott's Diagnostic Microbiology, Mosby

M. Sc. Microbiology

FOURTH SEMESTER

(January 2016 – June 2016)

PAPER-I: MICROBIAL BIOTECHNOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Techniques of Microbial technology: Scope of genetic engineering, restriction and modification enzymes, ligation and transformation, agarose and polyacrylamide gel electrophoresis, Southern, northern, western blotting, polymerase chain reaction, DNA sequencing, cloning vectors- plasmids, bacteriophages, phagemids, cosmids. YAC, BAC.

UNIT - II

Basics of Genomics, RNA interference, Cloning strategies, cDNA synthesis and cloning, mRNA enrichment, DNA primers, linkers, adaptors and their synthesis, library construction and screening; Cloning interacting genes, two and three hybrid systems, cloning differentially expressed genes, nucleic acid microarrays; Site directed mutagenesis and protein engineering, immobilization techniques.

UNIT - III

Microbial screening, selection and strain improvement, bacterial enterotoxins, peptide hormone, interferons. Biofertilizers, biopesticides, enzyme electrodes, enzyme in pulp and paper industry, Bioremediation

UNIT - IV

Role of national and international organization in biotechnology, cooperative efforts, government programs for biotechnology development and applications, patenting biotechnological process and products in different fields, regulation for bio-hazardous products.

Lab Course:

1. Bacterial culture and antibiotic selection media. Preparation of competent cells.
2. Isolation of plasmid DNA.
3. Isolation of Lambda phage DNA.
4. Estimation of nucleic acids.
5. Agarose gel electrophoresis and restriction mapping of DNA.
6. Construction of restriction map of plasmid DNA.
7. Cloning in plasmid/phagemid vectors.
8. Preparation of single stranded DNA template.
9. Gene expression in *E. coli* and analysis of gene product
10. PCR

Books Recommended:

1. Bruce A White (1997) PCR Cloning Protocols. Hanuman Press Totowa, New Jersey.
2. Bruce Birren, Eric D Green, Sue Klapholz, Trichard M Myers, Horald Riethman, & Jane Roskenus (1999) Genome Analysis: A Lab Manual vol.1,vol.2,vol.3, Cold Spring Harbor Lab. Press.
3. Daniel L Hartl, Elizabeth & Jones W (1998) Genetics: Principles and Analysis. Jones & Bartlett Publishers.
4. Davies JA & Rez WS (1992) Milestones in Biotechnology Classic papers on Genetic Engineering. Butterworth-Heinemann, Boston.
5. Glick Molecular Biotechnology.

6. Glover DM and Hames BD (1995) DNA Cloning: A practical approach, IRL Press, Oxford.
7. Kaufman PB, Wu W, Kim D and Cseke LJ (1995) Molecular and Cellular Methods in Biology and Medicine. C. Press, Florida.
8. Kingsman SM & Kingsman AJ (1998) Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes. Blackwell Scientific Publishers, Oxford.
9. Mickloss DA & Freyer GA (1990) DNA Science. A First Course in Recombinant Technology. Cold Spring Laboratory Press, New York
10. Primrose SB (1994) Molecular Biotechnology (2nd Edition). Blackwell Scientific Publishers, Oxford.
11. Sambrook, Fritsch EF and Maniatis (2000). Molecular Cloning: A Laboratory Manual. Cold Spring Laboratory Press, New York
12. Sambrook & Russell (2001) Molecular Cloning: A lab Manual (3rd Edition). Cold Spring Harbor Lab Press.
13. Strickberger MW (2000) Genetics (3rd Edition), Prentice Hall of India Pvt. Ltd.
14. Walker MR & Rapley R (1997) Route Maps in Gene Technology. Blackwell Scientific Publishers, Oxford.
15. Watson JD, Gilman N, Witkowski, Mark, Zoller . Recombinant DNA , Scientific American Books.
16. John Bulock and Bjorn Kristiansen. Basic Biotechnology Academic Press

M. Sc. Microbiology

FOURTH SEMESTER

(January 2016 – June 2016)

PAPER-II: MEDICAL MICROBIOLOGY - II

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT - I

Generation of diversity in BCR and TCR. Light and heavy chain gene recombination. Recombination Signal sequences. Heavy chain constant region genes. Class switching. Membrane and secreted immunoglobulins. Organization and arrangement of T-cell receptor genes.

UNIT - II

Synthesis and production of immunoglobulins. Monoclonal antibody. Designer antibody.
Regulation of immune response by antigen, antibody, immune complex, MHC and cytokines. Autoimmunity and autoimmune disorders. Immunological tolerance. Immunity to microbial and parasitic infections. Immunodeficiency diseases.

UNIT - III

Principles of antimicrobial action and resistance of antibiotics. Anti fungal and anti cancer compounds. Laboratory diagnosis and antimicrobial therapy; various methods of antimicrobial susceptibility testing. Antibiotic assay in body fluids. Nosocomial infection, common type of hospital infections and their diagnosis and control.

UNIT - IV

Immunoprophylaxis: Principles of Vaccination. Immunization practices. Vaccines against important bacterial and parasitic diseases. DNA vaccines; passive prophylactic measures. Viral vaccines and antiviral agents

Diagnosis of microbial diseases - Collection, transport and preliminary processing of Clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases. Modern methods of microbial diagnosis. Principles of immunodiagnostics. Antigen-antibody based immunodiagnosis and the techniques involved – Enzyme and Radial Immuno assays. Immunoblotting. Effector cell assays, Flow cytometry, Cytotoxic assays. Isolation of pure antibody. Application of monoclonal antibodies in immunodiagnosis.

Lab Course:

- Preparation of Parasite/ microbe Antigen and analysis by PAGE
- Immunizations and Production of Antibody
- Antigen antibody reaction by Double Diffusion, Counter Current and Immunoelectrophoresis, RID and EIA
- Western Blot Analysis
- Immunodiagnosis using commercial kits
- VDRL and RPR Test.
- Widal test

Books Recommended:

- Prescott & Dunn's. Microbiology. CBS Publishers & Distributors.
- Anantnarayan R and Panikar CKJ: Text book of Microbiology, Orient Blackswan Pvt. Ltd.
- Broude AI: Medical Microbiology and Infectious Diseases, WB Saunders Co.
- Chapel and Haeney: Essentials of Clinical Immunology, Blackwell Scientific Publications
- Kuby's Immunology: R.A. Goldsby, Thomas J Kindt and Barbara A. Osborne
- Immunology- A short Course: E. Benjamini, R. Coico and G. Sunshine
- Immunology: Roitt, Brostoff and Male
- Forbes BA, Sahm DF and Weissfeld AS: Bailey & Scott's Diagnostic Microbiology, Mosby

M. Sc. Microbiology

FOURTH SEMESTER

(January 2016 – June 2016)

PAPER-III: FOOD MICROBIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

Microbial flora of fresh food, grains, fruits, vegetables, milk, meat, eggs and fish. Microbiological examination of foods for their infestation by bacteria, fungi & viruses. Chemical preservatives and food additives. Factors influencing microbial growth in food- Extrinsic and intrinsic factors. Food as a substrate for micro-organism.

UNIT- II

Canning, processing for heat treatment - D, Z and F values and working out treatment parameters; microbial spoilage of canned foods, detection of spoilage and characterization. Mold and mycotoxin contamination of food, aflatoxins, ochratoxins, trichothenes, zearalenone, ergot mycotoxins. Role of microorganisms in beverages– beer, wine and vinegar fermentation.

UNIT- III

The roles of microorganisms in the food industry, positive and negative perspectives. Food-borne infections and intoxications: Bacteria and nonbacterial-with examples of infective and toxic types- *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia*; nematodes, protozoa, algae, fungi and viruses. Food borne outbreak- laboratory testing procedures; Sources and transmission of bacteria in foods: human, animal, and environmental reservoirs; cross-contamination.

UNIT- IV

Prevention Measures-Food sanitation in manufacture and retail trade; Plant sanitation- Employee's Health standards-waste treatment-disposal- quality control. Government Agency and Food Safety Policy: Government Branches (FDA, CDC, USDA and how they work to control food safety), HACCP, Risk Assessment.

Lab Course:

1. Isolation and identification of microorganisms from fermented food, fruits, cereal grains and oil seeds.
2. Determination of quality of milk sample by methylene blue reductase test.

Books Recommended:

- M.R. Adams and M.O. Moss: Food Microbiology, Royal Society, Cambridge
- William, C. Frazier and Dennis C. Westhoff: Food Microbiology, Tata McGraw Hill
- Banwart GJ: Food Microbiology CBS Publishers & Distributors, New Delhi.
- Hobbs BC and Roberts D: Food Poisoning and Food Hygiene, Edward Arnold, London

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FOURTH SEMESTER

(January 2016 – June 2016)

PAPER-IV: AGRICULTURAL MICROBIOLOGY

Max. Mark 80

(There will be 5 questions of equal marks. First question will be based on complete syllabus with no internal choice, whereas rest questions will be unit wise).

UNIT- I

Structure and characteristic features of the following biofertilizer organisms: Bacteria: Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia. Cyanobacteria: Anabaena, Nostoc, Fungi: Glomus, Gigaspora, Sclerocystis, Amanita, Laccaria.
Biofertilization processes - Decomposition of organic matter and soil fertility and vermicomposting. Mechanism of phosphate solubilization and phosphate mobilization.

UNIT- II

Biofertilizers – biological nitrogen fixation – nitrogenase enzyme – symbiotic nitrogen fixation- (Rhizobium, Frankia) – non symbiotic nitrogen fixation (Azotobacter - Azospirillum), VAM- ecto- endo-ectendo mycorrhizae and their importance in agriculture.

UNIT- III

Major biogeochemical cycles and the organisms: carbon – nitrogen - phosphorous and sulphur. Biopesticides: toxin from *Bacillus thuringiensis, Psuedomonas syringae.* Biological control - use of Baculovirus, protozoa and fungi.

UNIT- IV

Microbial diseases of crop plants: symptoms, causal organisms and control. Fungal diseases (Late blight of potato, Tikka disease of groundnut, red rot of sugarcane). Bacterial diseases (bacterial blight of rice, citrus

canker, Tundu disease of wheat) and
Viral diseases (Tobacco mosaic, leaf curl of papaya, yellow vein mosaic of bhindi).

Lab Course:

1. Isolation and enumeration of bacteria from different soil type.
2. Isolation and enumeration of fungi from different soil type
3. Preparation of Winogradsky Column to study the various soil micrflora.
4. Isolation of Rhizobium from root nodules.
5. Isolation of Azatobacter from soil.
6. Isolation of Cyanobacteria from peddy field.
7. Measurement of pH of soil sample.

Books Recommended:

- Bagyraj and Rangasamy: Agricultural Microbiology