

PROGRAMME GUIDE

MASTER OF SCIENCE (MICROBIOLOGY)

SESSION 2020-2021

- Scheme of Examination
- Detailed Syllabus



DR. C.V. RAMAN UNIVERSITY

KARGI ROAD, KOTA, BILASPUR, CHATTISGARH

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WEBSITE: WWW.CVRU.AC.

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DEAN
Faculty of Science,
Dr. C.V. Raman University,
Kota, Bilaspur,
(C.G.), India

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Deptt. of Life Sciences
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DEPARTMENT OF MICROBIOLOGY

INTRODUCTION

This programme is offered by the department of Microbiology as an effective program targeting the students who wish to pursue research and development in the field of Bacteriology, Virology, Immunology, Parasitology, Fermentation, Mycology, Phycology, Industrial microbiology, Agriculture and Food Microbiology or higher studies in the field of Microbiology. It offers in depth knowledge of teaching and research programs in diverse areas of microbiology viz Bacterial Microbiology, Enzymology, Applied Microbiology. The programs of MSc in Microbiology is a fulltime postgraduate degree program of a period of 2 years distributed in 4 semesters containing 20 credits per semester and 80 total credits in 4 semesters as per the norms and guidelines prescribed by UGC. The program consists of 4 courses of theory papers and 2 courses practical laboratories in each semester upto 3rd semester and 2 courses of theory papers and one laboratory with one major project work in its fourth semester along with appropriate incorporation of the core, Elective and discipline specific electives as the course attributes in a well defined manner in the curriculum. The programs of M.Sc. in Microbiology. Is a full-time Postgraduate degree program of a period of 2 years distributed in 4 semesters containing 20 credits per semester and 80 total credits in 4 semesters as per the norms and guidelines prescribed by UGC. The program consists of 4 courses of Theory papers and 2 courses of practical laboratories in each semester upto 3rd semester and 2 courses of theory papers and one laboratory with one major project work in its fourth semester along with appropriate incorporation of the Core, Elective & Discipline Specific Electives as the course attributes in a well defined manner in the curriculum. The M.Sc. program of Dr. C. V. Raman University targets to prepare its students as ready to work.


VISION

To develop the department of microbiology as a center of excellence for research and knowledge resource. To promote understanding the Inter-Intra discipline research activity and competence building. To promoting Quality research in faculty of Life-Science discipline and scientific temperament.

MISSION


- To make quality Pre and Post Ph.D. education accessible to all sector of Society including Tribal Population of Chhattisgarh.
- To provide quality education in Inter and Intra discipline of Zoology, Botany, Microbiology and Biotechnology.
- To develop human resource with International class competence and skills in respective discipline.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's):


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- The objective of the Master's programme in Biotechnology is to equip the students to apply the knowledge of Microbes and their uses in different field.
- The laboratory training and Pathogenicity analysis of microbes in Microbiology. prepare the students for their careers in the Medical and industrial area.
- The student have a knowledge of different culture Skill viz Blood culture, Urin –Culture , Pus culture . Identification of microbes and their causing diseases and control to develop own Business, marketing and self employment.
- The goal is to impart student the knowledge and skills which are contemporary and useful to them as well as for society. The student will write the standard operating protocols (SOPs) and identify requirement for experimental Microbes, ethics and welfare.
- Large scale production of microbes through fermentation process and uses of their secondary metabolites (Byproducts) in different field.

Program Name: M.Sc.(MICROBIOLOGY):

Program Outcomes (PO's)

- [PO.17.] **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking & actions.
- [PO.18.] **Effective communication:** Speak, read, write & listen clearly in person and through electronic media in English and in one Indian Language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.19.] **Social interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.20.] **Effective citizenship:** Demonstrate empathetic social concern and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.21.] **Ethics:** recognize different value systems including your own, understand the moral dimensions of decisions and accept the responsibility for them.
- [PO.22.] **Environment and sustainability:** Understand the issues of environmental contents and sustainable development in terms of biotechnology.
- [PO.23.] **Self-directed and long-life learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-economic and socio technological changes & develop an aptitude for continuous learning and professional development with ability to engage in biotechnological practices and education program.
- [PO.24.] **Knowledge:** Provide basic knowledge for understanding the principles and their applications in the area of biotechnology, Instrumentation & Technology.
- [PO.25.] **Technical Skills:** Develop an ability to use various instruments and equipment with an indepth knowledge on standard operating procedures for the same.
- [PO.26.] **Research & Development:** To Demonstrate knowledge of identifying a problem, critical thinking, analysis and provide rational solutions in different disciplines of Biotechnology & biotechnological Sciences.
- [PO.27.] **Modern Tool Usage:** Develop appropriate technique, resources and IT tools for prediction and modelling to complex issues of Biotechnobiology.

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[PO.28.] **The Society:** Apply regional biotechnological reasoning informed by the contextual knowledge to comprehend and receive instructions on safety and the consequent responsibilities relevant to the society as well as social well being.

[PO.29.] **Problem analysis**

[PO.30.] **Conduct investigations of complex problems**

[PO.31.] **Design/Development of Solutions**

[PO.32.] **Individual and Teamwork**

Program Name: M.Sc.(MICROBIOLOGY):

Program specific outcomes (PSO's)

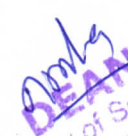
PSO1-Industry applications of better understanding of the key principles of biochemical functioning at an advanced level

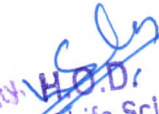
PSO2-To get better awareness of the major issues at the forefront of the discipline of Biotechnology.

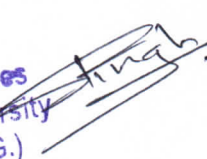
PSO3-Possess an in-depth understanding of the area of Biotechnology & biochemistry chosen for research emphasis

PSO4-ability to design and carry out experiments (safely) and to interpret experimental data


PSO5-production of substantial original research of significance and quality sufficient for publication of ability to present their work through written, oral, and visual presentations, including an original research proposal awareness of ethical issues in biochemical & Biotechnological research and careers options.


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MASTER OF SCIENCE (MICROBIOLOGY)

Duration: 24 Months (2Years)
Eligibility: Graduation with Science Subjects

COURSE STRUCTURE M.SC MICROBIOLOGY SEMESTER Ist													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
6SMMB101	Core Course	General Microbiology	100	50	17	20	08	30	12	4	-	-	4
6SMMB102	Core Course	Virology	100	50	17	20	08	30	12	4	-	-	4
6SMMB103	Core Course	Research Methodology& Techniques	100	50	17	20	08	30	12	4	-	-	4
6SMMB104	Core Course	Biochemistry	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMMB105	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2
6SMMB106	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2
	Grand Total		500							16	-	4	20

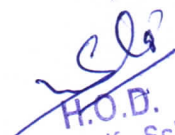
Minimum Passing Marks are equivalent to Grade D

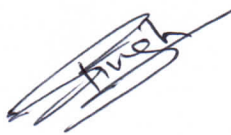
Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage – Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

L- Lectures T- Tutorials P- Practical



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COURSE STRUCTURE M.SC MICROBIOLOGY SEMESTER IInd

COURSE STRUCTURE M.SC MICROBIOLOGY SEMESTER IIInd														
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits	
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution	
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks					
Theory Group														
6SMMB201	Core Course	Microbial Physiology and Metabolism	100	50	17	20	08	30	12	4	-	-	4	
6SMMB202		Food Microbiology & Toxicology	100	50	17	20	08	30	12	4	-	-	4	
6SMMB203		Immunology	100	50	17	20	08	30	12	4	-	-	4	
6SMMB204		Pharmaceutical Microbiology	100	50	17	20	08	30	12	4	-	-	4	
Practical Group				Term End Practical Exam		Lab Performance		Sessional						
6SMMB205	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2	
6SMMB206	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2	
Skill Courses								Sessional						
	Skill Enhancement	Skill EnhancementElective Course-1	50	-	-	-	-	50	20	1	-	1	2	
	Grand Total		550							17		5	22	

Minimum Passing Marks are equivalent to Grade D


L- Lectures T- Tutorials P- Practical

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage - Attendance 50%, Three Class Tests/Lab Performance Assignment 50%

Skill Elective I - Any other course being offered in this semester as per the list given at the end of course structure.



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COURSE STRUCTURE M.SC MICROBIOLOGY SEMESTER IIIrd													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
6SMMB301	Core Course	Molecular Biology and Microbial Genetics	100	50	17	20	08	30	12	4	-	-	4
6SMMB302	Core Course	Industrial Microbiology	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –I (Select anyone from below given Elective-I)	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –II (Select anyone from below given Elective-I)	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMMB313	Practical	LAB 1	50	25	08	-	-	25	08	-	-	2	2
6SMMB314	Practical	LAB 2	50	25	08	-	-	25	08	-	-	2	2
Skill Courses								Sessional					
	Skill Enhancement	Skill EnhancementElective Course-1	50	-	-	-	-	50	20	1	-	1	2
	Grand Total		550							17	-	5	22

Minimum Passing Marks are equivalent to Grade D

L- Lectures T- Tutorials P- Practical

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage - Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

Skill Elective I - Any other course being offered in this semester as per the list given at the end of course structure.

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Eligibility: Graduation with Science Subjects

COURSE STRUCTURE M.SC MICROBIOLOGY SEMESTER IVth													
Course Details				External Assessment		Internal Assessment				Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor		Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group													
****	Discipline Specific Elective	Elective –III (Select anyone from below given Elective-I)	100	50	17	20	08	30	12	4	-	-	4
****	Discipline Specific Elective	Elective –IV (Select anyone from below given Elective-I)	100	50	17	20	08	30	12	4	-	-	4
Practical Group				Term End Practical Exam		Lab Performance		Sessional					
6SMMB411	Practical	LAB-I	50	25	08	-	-	25	08	-	-	2	2
6SMMB412	Practical	LAB-II	50	25	08	-	-	25	08	-	-	2	2
6PRSC401	Research Component	Project/Internship/Field work & Viva Voce	200	100	33	-	-	100	40	-	-	8	8
	Grand Total		500							8	-	12	20

Minimum Passing Marks are equivalent to Grade D

Major- Term End Theory / Practical Exam

Minor- Pre University Test

Sessional weightage – Attendance 50%, Three Class Tests/ Lab Performance Assignment 50%

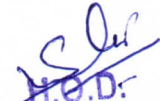
Compulsory Project/Dissertation with choice in any Disciplinary specific elective. Compulsory one paper presentation certificate in related discipline.


L- Lectures T- Tutorials P- Practical

PROJECT

All the candidates of M.Sc. (Microbiology) are required to submit a project-report based on the work done by him/her during the project period. A detailed Viva shall be conducted by an external examiner based on the project report. Students are advised to see the detailed project related guidelines on the website of RNTU. (www.rntu.ac.in) under Project Guidelines for student section.

Outcome-The student will identify a problem on which he/she would be able to work, identify the scope of research on the chosen topic and will frame the objectives to be addressed in the project through a w


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SPECILIZATION WITH ELECTIVE

***Note** - Students need to select any one group and choose any two subjects from selected group for third and fourth semester.

Electives for Third Semester			Electives for Fourth Semester		
Course Code	Course Type	List of Electives	Course Code	Course Type	List of Electives
GROUP ELECTIVE -I Name – Microbiology			GROUP ELECTIVE -III Name – Microbiology		
6SMMB303	Discipline Specific Elective-1	Environmental and Agricultural Microbiology	6SMMB401	Discipline Specific Elective-3	Mycology, Phycology & Protozoanology
6SMMB304	Discipline Specific Elective-1	Parasitology	6SMMB402	Discipline Specific Elective-3	Soil Microbiology
6SMMB305	Discipline Specific Elective-1	Bioenergetics and Molecular	6SMMB403	Discipline Specific Elective-3	Microbial diversity and Extremophiles
6SMMB306	Discipline Specific Elective-1	Bioinstrumentation	6SMMB404	Discipline Specific Elective-3	Microbial Genetics
6SMMB307	Discipline Specific Elective-1	Microbial Physiology	6SMMB405	Discipline Specific Elective-3	Recombinant DNA Technology
GROUP ELECTIVE -II NAME: Microbiology			GROUP ELECTIVE -I V Name – Microbiology		
6SMMB308	Discipline Specific Elective-2	Medical Microbiology	6SMMB406	Discipline Specific Elective-4	Microbial Ecology
6SMMB309	Discipline Specific Elective-2	Applied Microbiology	6SMMB407	Discipline Specific Elective-4	Cell tissue & Organ culture
6SMMB310	Discipline Specific Elective-2	Bioinformatics, Microbial Genomics and Proteomics	6SMMB408	Discipline Specific Elective-4	Biomathematics
6SMMB311	Discipline Specific Elective-2	Bacteriology	6SMMB409	Discipline Specific Elective-4	Inheritance Biology
6SMMB312	Discipline Specific Elective-2	Advances in Microbiology	6SMMB410	Discipline Specific Elective-4	Biosafety and Intellectual Property Rights


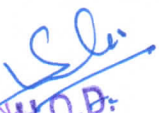
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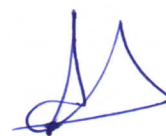
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SKILL ENHANCEMENT ELECTIVE COURSES

Non-Technical			
Elective No.	Department/ Faculty Name		
	Faculty of Information Technology		
I	SCIT 201	Data Entry Operation	2(1+0+1)
II	SCIT 301	Multimedia	2(1+0+1)
III	SCIT 501	Web Designing with HTML	2(1+0+1)
IV	SCMIT 201	Web Development	2(1+0+1)
V	SCMIT 301	LINUX	2(1+0+1)
	Faculty of Management		
I	SMGT 201	Briefing and Presentation Skills	2(1+0+1)
II	SMGT 301	Resolving Conflicts and Negotiation Skills	2(1+0+1)
III	SMGT 802	Entrepreneurship Development	2(1+0+1)
	Faculty of Commerce		
I	SCOM 201	Tally ERP 9	2(1+0+1)
II	SCOM 302	Multimedia	2(1+0+1)
III	SCOM 803	Data Analyst	2(1+0+1)
	Faculty of Humanities		
I	SHBA 301	Pursuing Happiness	2(1+0+1)
II	SHBA302	Communication Skill and Personality Development	2(1+0+1)
III	SHMA301	Tourism in M.P	2(1+0+1)
	Faculty of Science		
I	SSBI 301	Mushroom Cultivation	2(1+0+1)
II	SSPH 301	House Hold Wiring	2(1+0+1)
III	SSPH 301	Basic Instrumentation	2(1+0+1)
IV	SSPH 301	DTP Operator	2(1+0+1)
V	SSCH 301	Graphic Designing	2(1+0+1)
	Faculty of Education		
I	SCBE 403	Understanding of ICTC (Information Communication Technology)	2(1+0+1)
II	SCPE 201	Yoga Education	2(1+0+1)


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SEMESTER- 1st

Course: M.Sc. Microbiology

SUBJECT: General Microbiology

Course Code: 6SMMB101

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: Microbiology is the study of organisms that are too small to be observed with the naked eye.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	History of Microbiology. Microscopy. Structure of microbial cells: Spontaneous generation and germ theory of disease, Contributions of Antony van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky, Beijerinck, Alexander Fleming, Waksman. Developments in modern biology. Principles and working of bright field microscope, fluorescent microscope, Phase contrast microscope, electron microscope. Application and importance of above microscopes. Measurement of microscopic objects. Prokaryotic cell, Eukaryotic cell, Organization and function of cellular organelles. Cell wall of bacteria, cell membranes, flagella, pili, capsule structure, chemical structure of peptidoglycan, protoplasts, spheroplasts, microsomes and ribosomal RNAs, Nuclear material/nucleus.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Methods of sterilization: Physical methods - Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level. Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation and pure culture development. Preservation and Maintenance of Microbial Cultures: Repeated subculturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, freeze-drying (lyophilization). Advantages and disadvantages of each method.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Identification methods and classification of bacteria: - Microscopic identification characteristics, staining methods - simple staining, differential staining, structural staining and special staining methods. Ecological identification methods, Nutritional (cultural) identification characters, chemical identification characters, biochemical identification methods, immunological characteristics, pathogenic properties identification, genetic characteristics identification.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Principles of bacterial taxonomy and classification: - Numerical taxonomy, Bergy's manual and its importance, general properties of bacterial groups. Rickettsiae- General characters and their importance; Mycoplasma - general characters; Chlamydiae - TRIC agents and LGV.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Algae, Fungi and their characters: Distribution of algae, thallus organization, products of algae and their importance. Reproduction, Biochemical classification of algae. Vegetative body of fungi, reproduction, fruiting bodies and dispersal of fungal propagules. Nutritional groups and habitat relationships of fungi. Economic importance of fungi. Classification of fungi.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: This course focuses on the general principles of microbiology.

TEXT / REFERENCE - BOOKS:

- Introduction to Algae by Morris, I.
- Products and Properties of Algae by Zizac.
- Fresh water algae of the United States by Smith, GM.
- Introductory Mycology, by Alexopolus, C.J.
- Dispersal in Fungi by Ingold, CT
- Microbial Physiology by Moat,
- Laboratory Experiments in Microbiology by Gopal Reddy et al
- Microbes in Action by Seoley HW and Van-Demark, PJ Brock's
- Biology of microorganisms by Madigan, MT et al

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Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 1st

Course: M.Sc. Microbiology

SUBJECT: Virology

Course Code: 6SMMB102

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: How virus and host factors interact and how these interactions lead to disease and/or recovery.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Brief account of discovery of viruses, chemical composition of viruses; morphology, architecture, principles of symmetry with reference to T4, TMV, Adeno, Polio, Influenza, Rhabdo, Reo and HIV viruses. Nucleic acid diversity in viruses; Subviral particles-Prions, virusoids, satellite viruses. General idea about cyanophages, actinophages and mycophages	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Taxonomy of viruses: classification and nomenclature of viruses as per ICTV. c. Isolation, purification, cultivation, assay and characterization of plant, animal and bacterial viruses. Cultivation of plant and animal viruses. Purification and maintenance of viruses. Quantitation of viruses (viral assays).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	(a). Life cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, and X 174. Importance of phages.(b). Classification and nomenclature of plant viruses, replication of TMV and CAMV. Classification and replication of animal viruses (Adeno, Influenza, Herpes, Hepatitis and Retro viruses).(c). Transmission and management of plant and animal viral diseases (interferons, antiviral drugs and vaccines eta.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Recombination in phages, multiplicity reactivation and phenotypic mixing General account of Tumor virus (RNA and DNA). Viral Interference and Interferons. Nature and source of interferons, Classification of interferons. Induction of interferon. Antiviral agents (chemical and biological) and their mode of actions	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Structure and Replication strategies of animal Adeno, Influenza, Retro viruses (HIV) and Hepatitis B. Viruses as cloning vectors: Vectors used for cloning and sequencing: λ phage, M 13, retro viruses. CaMV 35S promoter and its application in genetically modified crops. Baculovirus System for insect cell lines.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: The student will be able to evaluate problems in modern virology including areas of virus biology.

TEXT / REFERENCE - BOOKS:

- General Virology by Luria and Darnel
- Virology and Immunology by Jokli
- Text book of Virology by Rhodes and Van Royen
- Plant Virology by Smith
- Genetics of bacteria and their viruses by W. Hayes



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- Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
- A laboratory guide in virology by Chjarles H. Lunningham
- Basic lab procedures in diagnostic virology by Marty Cristensen

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy


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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 1st

Course: M.Sc. Microbiology

SUBJECT: Research Methodology & Techniques

Course Code: 6SMMB103

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: Research method is characterized by the techniques employed in collecting and analyzing data.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Optical methods; colourimetry and spectrophotometry, fluorimetry, optical rotation Circular dichroism, NMR, ESR spectroscopy, x-ray diffraction, types of mass spectrometry. Electrophoretic techniques and application, counter current distribution.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Separation methods: Chromatographic techniques – HPLC, FPLC paper, thin layer, ion exchange, gel filtration and affinity chromatography. Diffusion, dialysis, cell disruption methods, centrifugation techniques, cell free extracts and their use in metabolic studies	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	(Radio isotopes – detection and measurement of radioactivity – scintillation counters, autoradiography, stable isotopes and their use. Safety precautions. General method of study of intermediary metabolism in microbes. Uses of mutants in study of metabolism.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Population, samples and sampling procedures, variables, variations and frequency distributions, measures of central tendency and dispersion, element of probability, gaussian or normal distribution, binomial distribution, poisson distribution, 't' distribution, 'F' distribution and Chi-square distribution, correlation and linear regression. Normal curve test, 't' test, 'F' test, ANOVA, analysis of covariance, Chi-square test, and confidence intervals. Experimental designs using statistical tools.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Introduction to Computers Introduction to disk operating systems (DOS): Sample commands, DIR-CD-RD-DEL- COPY-MOVE-REN-TYPE-EDIT (Editor) CE-DATE and TIME. Introduction to Windows: Word Processing: Electronic Spread Sheet Data collection, Data representation, Manuscript preparation, Research ethics, QA, QC, GLP, GMP, Patents & IPR	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: In this course, student should be able to assess critically the following methods:- literature, case study, structured surveys, interviews, focus graphs.

TEXT / REFERENCE - BOOKS:

- Biochemistry by Lehninger
- Outlines of Biochemistry by Cohn and Stumph
- Biological Chemistry by Mullar and Cards
- Biochemistry by White, Handler and Smith
- Methods in Enzymology series The Cell – Bratch and Mirsky
- series Laboratory experiments in Microbiology by Gopal Reddy et al
- Biochemistry lab manual by Jayaraman
- Introduction to the theory of statistics by Alexander, M Mood and Franklin
- Fundamentals of Biometry by L.N.Balam

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 1st
Course: M.Sc. Microbiology
SUBJECT: Biochemistry

Course Code: 6SMMB104
Max. Marks: 50
Min. Marks: 17

COURSE OBJECTIVE: Objective of biochemistry is the complete understanding at the molecular level of all of the chemical processes associated with living cells.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	pH and its biological relevance Determination of pH, preparation of buffers, Concept of entropy, free-energy, free energy changes, high energy compounds. Equilibrium constants, Redox potentials, Biological redox systems, Biological oxidation, Biological redox carriers, <u>biological membranes, electron transport, oxidative phosphorylation and mechanism.</u>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic
Unit-II	Lipids classification: Bacterial lipids, prostaglandins, structure, function, Major steroids of biological importance. Carbohydrates: Classification, basic chemical structure, monosaccharides, aldoses, and ketoses, cyclic structure of monosaccharides, stereoisomerism, anomers and epimers. Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Nucleic acids: Structure and properties of purines, pyrimidines, nucleosides and nucleotides. Metabolism of purines and pyrimidines - Biosynthesis and degradation Proteins and amino acids: Properties of amino acids, structure, confirmation and properties of proteins, metabolism of amino acids, biosynthesis and degradation – an overview	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Enzymes nomenclature, classification methods for determination of enzyme activity. Isolation and purification of enzymes. Enzyme kinetics: Effect of pH, substrate concentration, temperature and inhibitors. Mechanism of enzyme action - <u>Action of Hydrolases, Pencillinacylases, Oxidases and reductases</u>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Coenzyme catalysis(pyridoxal phosphate and TPP).Isoenzymes.Competitive and non-competitive inhibition. Methods for increased microbial enzymes production and activity. Control of enzymes. <u>Regulation of enzyme activity:</u> allosteric enzymes and feedback mechanisms. Metabolic compartmentalization in relation to enzyme, enzymes and secondary metabolites	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: Student will be able to demonstrate an understanding of fundamental biochemical principles such as the structure/function of bimolecular, metabolic pathways and the regulation of biological/biochemical processes. **TEXT /**

REFERENCE - BOOKS:

- Biochemistry by Lehninger
- Outlines of Biochemistry by Cohn and Stumpff
- Biochemistry of Nucleic acids by Davidson
- Biological Chemistry by Mullar and Cards
- Biochemistry by White, Handler and Smith
- Methods in Enzymology series
- The Cell – BratchamdMirsky series
- Biochemistry lab manual by Jayaraman

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 1st

Course: M.Sc. Microbiology

SUBJECT: LAB (GENERAL MICROBIOLOGY & VIROLOGY)

Subject Code: 6SMMB105

Practical Max. Marks: 25

Practical Min. Marks: 08

Objective:- virology is a field within microbiology that encompasses the study of viruses. Purpose of this lesson is to provide a general overview of laboratory techniques.

Paper I General Microbiology (Practicals)

1. General instructions, Microbiology laboratory and its discipline Handling of microscopes,
2. Calibration and measurement of microscopic objects
3. Staining techniques for bacteria – simple, differential and special stainings
4. Preparation of media and reagents/stains
5. Sterilization procedures/methods Isolation and cultivation of pure cultures
6. Identification methods of bacteria
7. Isolation and culturing of fungi (yeasts and molds) and algae
8. Observation of specimen and permanent slides

Paper II Virology (Practicals)

1. Isolation of phage from soil/sewage.
2. Cultivation and preservation of phages
3. Quantitation of phages
4. Plaque neutralization Growth phages of phage and burst size
5. Isolation of plaque type and host range mutants
6. Phage induction Lysogeny-Transduction Cultivation of animal viruses in egg allantoic, amniotic and CAM
7. Demonstration of cytopathological changes (slides/pictures)
8. Symptomatic observations of plant viral infections

Outcome:- students are expected to be able to understand the molecular biology of viruses.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 1st

Course: M.Sc. Microbiology

SUBJECT: LAB (RESEARCH METHODOLOGY & BIOCHEMISTRY)

Subject Code: 6SMMB106

Practical Max. Marks: 25

Practical Min. Marks: 08

Objective:- To impart latest information on the molecular biochemistry of isolation, transfer and expression of genes.

Paper II Research Methodology and Techniques (Practicals)

1. Creating documents using word processor
2. Usage of spread sheet to biological applications
3. Biochemistry calculations and statistics
4. Absorption maxima of proteins, NA, Aromatic aa and riboflavin.
5. Differential centrifugation
6. Paper chromatography:
7. sugars Dialysis
8. Demonstration of Gel filtration technique
9. Demonstration of electrophoresis
10. Partial purification of enzymes (α -amylase, urease and catalase, alkaline phosphatase)
11. Effect of substrate concentration, pH, time and temperature on enzyme activity
12. Calculation of K_m for partially purified enzyme
13. Study for inhibition of enzyme activity

Biochemistry (Practicals)

1. Safety and good lab practices Preparation of buffers and adjustment of pH
2. Qualitative tests for carbohydrates and analysis of unknown
3. Qualitative tests for amino acids and analysis of unknowns
4. Quantitative estimation of inorganic and organic phosphate Tests for lipids (qualitative)
5. Quantitative estimation of glucose and fructose
6. Determination of saponification value and iodine number of fats

Outcome:- students will understand the importance of proteins, carbohydrates, lipid.

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SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: MICROBIAL PHYSIOLOGY AND METABOLISM

Course Code: 6SMMB201

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: In this course, we will explore the vast range of physiologies and metabolisms found throughout the microbial world

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Microbial nutrition - Elemental nutrient requirements of microbes, nutritional groups of bacteria. The autotrophy - Photoautotrophy and bacterial photosynthesis Chemoautotrophy and autotrophic metabolism. Concept of heterotrophy - Photoheterotrophy and chemoheterotrophy. Heterotrophic metabolism in bacteria.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Microbiological media and cultivation of microorganisms - Autotrophic media, defined synthetic mineral media, heterotrophic media. The concept of prototrophs and auxotrophs, prototrophic (minimal) media (defined media), complex media (undefined media), Basal medium, enriched media, enrichment media, selective media, biochemical media differential media, maintenance media, transport media.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Media for cultivation of fungi, and algae Cultivation methods of bacteria, slant culturing, stab culturing, agar plate culturing, rolled tube/bottle culturing, tube cultures, flask culturing. Aerobic culturing methods, anaerobic culturing methods. Environmental requirements of growth. Microbial growth: The concept of growth and definition, formation of protoplasm, building of macromolecules from elemental nutrients, supramolecules, orgnelles of cell and cellular components.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Cell cycle in microbes and generation time. Growth phases of bacteria - Lag phase, exponential (logarithmic) phase, stationary (ideo) phase, decline and survival of microbial cells. Importance of each growth phase. Synchronous cultures - methods of synchronous culturing, Continuous culturing methods, factors effecting growth. Methods of growth measurement. Cell - cell signaling, cross kingdom talk. Quorum sensing: compounds Acyl Homoserine lactones.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Nature and properties of spores: Bacterial endospore structure, phenomenon of sporulation, biochemistry and genetics of sporulation. Induction of sporulation phenomenon. Germination of spores Respiration (Aerobic and anaerobic) and fermentation. Glycolysis (EMP, HMP and ED) pathways. TCA Cycle and its integration. Biological membranes structure and function Electron transport, oxidative phosphorylation and their mechanism.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: The student have a knowledge of how microbial cell structures growth and metabolism function in living organisms.

TEXT / REFERENCE - BOOKS:

- Text book of Microbiology by M. Burrows;
- General Microbiology by Stainier, Deudroff and Adelberg;
- Review of medical microbiology by Jawitz, melnick and Adelberg
- Bacterial and Mycotic infections of man. Ed. Dubos and Hirst Lipincott;
- Principles of Microbiology and Immunology by Davis, Dulbecco, Eison, Ginsberg and Wood.;
- Text book of Microbiology by Ananthanarayanan;
- Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: FOOD MICROBIOLOGY AND TOXICOLOGY

Course Code: 6SMMB202



Max. Marks: 50

Min. Marks: 17

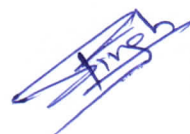
COURSE OBJECTIVE: In this course, the study of microorganisms involving both beneficial and deleterious effects of microbes on the quality and safety of processed and raw food materials.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Introduction to fermented foods, Microbial products of milk. Microbiology of cheese, butter, yogurt, Microbiology of bread, sauerkraut, idly Bacteriological examination of fresh and canned foods Spoilage of foods and factors governing the spoilage Food preservation methods. Role of microorganisms in beverages– beer, wine and vinegar fermentation. Dairy Microbiology - Types of microorganisms in milk, significance of microorganisms in milk, microbiological examination of milk, control of microbial flora of milk Microbes and animal interactions – Rumen Microbiology Termite microbial communities, Silage.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Mycotoxins: Groups of mycotoxins, effects on human and animal health, Detoxification methods(Physical, Chemical and biological). Mechanism of toxicity, Microbial threats and Bioterrorism, Test procedures to detect disturbances of microbial communities. Current and future implications concerning food safety, hazards and risks.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	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. 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.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	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.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	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.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: The student has knowledge of how food poisoning, food spoilage, preservation of food is dealt under food microbiology.


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TEXT / REFERENCE - BOOKS

- Food Microbiology by Frazier
- Microbial Ecology – A conceptual approach by Lynch and Poole
- Basic food microbiology (Abridged edition) by George J. Banwart
- Laboratory experiments in microbiology by Gopal Reddy et al Brock's
- Biology of Micro organisms by Madigan et al Probiotics 3 by R. Fuller, G. Perdigon (Kluwer Academic Publishers)
- Probiotics and Prebiotics: Scientific Aspects by Gerald W. Tannock University of Otago, Dunedin, New Zealand (Caister Academic Press)

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: IMMUNOLOGY

Course Code: 6SMMB203

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: In this course, understand the overall organization of the immune system.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	History of immunology. Hematopoiesis, Cell lineage, components of immune system, cells and organs of immune system. Antigens –Nature, properties and types. Haptens Antibody -Structure , functions and classification. Isotypes, allotypes and idiotypes. Immunoglobulin genes. Generation of antibody diversity. Clonal nature of the immune response - clonal selection theory.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Overview of Innate and adaptive immunity. T cell and B cell receptors. T cell B cell interactions. Immunological tolerance-central and peripheral Major Histocompatibility Complex (MHC). Human leucocyte antigen (HLA) restriction Processing and presentation of antigen by MHC.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Transplantation immunity, Auto immunity. Inflammation, Hypersensitivity - immediate and delayed type hypersensitivity reactions. Antigen and antibody reactions-Agglutination, Precipitation, neutralization , Complement fixation, classic and alternative pathways and function.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Labeled antigen-antibody reactions- ELISA, RIA, immune blot, immunoflourescence ,cell sorting-flow cytometry. Development Of immuno diagnostic kits.Types of vaccines and principles of Immunization	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Hybridoma techniques and monoclonal antibody production - Myeloma cell lines, fusion of myeloma cells with antibody producing B-cells, fusion methods. Selection and screening methods for positive hybrids, cloning methods. Production, purification and characterization of monoclonal antibodies. Applications of monoclonals in biomedical research, clinical diagnosis and treatment. Tumor immunology. Immuno diagnosis and immune therapy of cancer.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: This course is to help students develop the skills necessary for the critical analysis of contemporary literature on topics related to health and disease.

TEXT / REFERENCE - BOOKS:

- Immunology and immunopathology by Stewart Sell
- Cellular and molecular immunology by Abul K. Abbas et al
- Immunology by Herman N. Eosen
- Test book of Immunology by Barret
- Molecular basis of immunology by Constantin Bena
- Immunology – The science of self-non self discrimination by Jan Klein
- Essential Immunology by Roitt, IM Immunology by Kuby, J.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: PHARMACEUTICAL MICROBIOLOGY

Course Code: 6SMMB204

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: in this course, generally pharmaceutical microbiology provides knowledge of the presence of bacteria, yeasts, moulds, viruses and toxins in pharmaceutical raw material.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	The ecology of microorganisms affecting pharmaceutical industry - The atmosphere, water, skin & respiratory flora of personnel, raw-materials, packing, equipments, building, utensils etc. Types of microorganisms occurring in pharmaceutical products. Microbiological spoilage prevention of pharmaceutical products - Microbial spoilage, preservation of pharmaceutical products; antimicrobial agents used as preservatives. evaluation of the microbial stability of formulation	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	The sterilization in pharmaceutical industry and sterile pharmaceuticals - Heat, radiation, gaseous and filtration sterilization, injectable, sterile fluids Sterilization control and sterility testing - Sterilization indicators, automation, sterility testing methods. Good manufacturing practices and hygiene in industry and hospital.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Non-Medicinal antimicrobial agents - Bacteriostatic and bactericidal agents, factors affecting antimicrobial activity. Non medicinal antimicrobial chemicals - sanitizers, disinfectants, antiseptics, antimicrobial action of phenols and phenolic compounds, alcohols, halogens, heavy metals, dyes, aldehydes, detergents. Medicinal antimicrobial agents: Development of synthetic drugs - Sulphanamides, antitubercular compounds, nitrofurons, nalidixic acid, metronidazole group of drugs. Antibiotics - The origin, development and definition of antibiotics as drugs, types of antibiotics and their classification. Non-medical uses of antibiotics	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	History of chemotherapy - plants and arsenicals as therapeutics, Paul Ehrlich and his contributions, selective toxicity and target sites of drug action in microbes. Principles of chemotherapy - Clinical and lab diagnosis, sensitivity testing, choice of drug, dosage, route of administration, combined/mixed multi drug therapy, control of antibiotic/drug usage Mode of action of important drugs - Cell wall inhibitors (Betalactam - eg. Penicillin), membrane inhibitors (polymyxins), macromolecular synthesis inhibitors (streptomycin), antifungal antibiotics (nystatin)	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	The drug resistance - The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria. Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay Assay for growth inhibiting substances - Assay for non-medicinal antimicrobials (Phenol coefficient/RWC). Drug sensitivity testing methods and their importance. Assay for antibiotics - Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method). Introduction to pharmacokinetics.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: this course is to help student will be able to develop expertise in identification, cultivation and counting of microorganisms, preparation and sterilization of bacterial culture, various staining techniques, aseptic processing etc.

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TEXT / REFERENCE - BOOKS:

- Disinfection, sterilization and preservation. Block, S.S. (ed). Lea and Febigor, Baltimore Pharmaceutical Microbiology. Huge, W.B. and Russel, AD. Blackwell Scientific, Oxford
- Principles and methods of sterilization in health sciences. Perkins, JK. Pub: Charles C. Thomas, Springfield.
- Compendium of methods for the microbiological examination of foods. Vanderzant, C. and Splittstoesser, D. Pub: American Public Health Association, Washington, D.C.
- Disinfectants: Their use and evaluation of effectiveness. Collins, CH., Allwood, MC., Bloomfield, SF. And Fox, A. (eds). Pub: Academic Press, New York
- Inhibition and destruction of microbial cell by Hugo, WB. (ed). Pub: Academic Press, NY

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: LAB (MICROBIAL PHYSIOLOGY & TOXICOLOGY)

Subject Code: 6SMMB205

Max. Marks: 25

Min. Marks: 08

Objective:- In this Practical the study of microorganisms involving both beneficial and deleterious effects of microbes on the quality and safety of processed and raw food materials.

Paper I Microbial Physiology and Metabolism (Practicals)

1. Preparation of microbiological media.
2. Autotrophic media, minimal media, basic media, enriched media, enrichment media, differential media.
3. Isolation and cultivation of autotrophic microbes
4. Culturing methods of microbes – slant and stab cultures, tube culture, flask cultures, shake flask cultures
5. Anaerobic culturing methods – anaerobic jar and its use,
6. pyrogallol method,
7. thioglycollate media culturing,
8. anaerobic glove box and its application
9. Microbial growth experiments – Viable count of growing cultures and generation time determination
10. Determination of microbial growth by turbidometric
11. methods Study of bacterial growth curve
12. Factors affecting the microbial growth
13. Methods studying microbial respiration

Paper I - Food Microbiology and Toxicology (Practicals)

1. Microbiological examination of fresh and canned foods and mushrooms
2. Microbiological examination of spoiled foods and fruits
3. Microbiological examination of milk and milk products
4. Determination of quality of milk sample by methylene blue reductase test (MBRT test)
5. Isolation and cultivation of anaerobic microbes from rumen and termites
6. Isolation of toxin producing organisms and estimation of their toxins in different foods
7. Extraction of Mycotoxins from contaminated food.
8. Detoxification of mycotoxins.
9. Isolation of bacterial and fungal probiotics
10. Development of probiotics in vitro
11. Test procedures to detect disturbances of microbial communities
12. Isolation and identification of microorganisms from fermented food, fruits, cereal grains and oil seeds.

Outcome:- The student has knowledge of how food poisoning, food spoilage, preservation of food is dealt under food microbiology practical.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 2nd

Course: M.Sc. Microbiology

SUBJECT: LAB (IMMUNOLOGY & PHARMACEUTICAL MICROBIOLOGY)

Subject Code: 6SMMB206

Max. Marks: 25

Min. Marks: 08

Objective:- The student will be able to identify the cellular and molecular basis of immune responsiveness.

Paper II Immunology (Practicals)

1. Agglutination reactions – Widal, VDRL, HA,
2. Blood typing – tube method
3. Precipitation test: Ring interphase,
4. single radial diffusion, Ouchterlony, immunoelectrophoresis
5. Neutralization test – Plaque neutralization, HAI, Haeme adsorption test
6. Separation of serum, WBC, RBC, Plasma, CBP and differential blood picture.
7. Separation of serum proteins Blot transfer and detection of protein on blot by staining
8. ELISA Indirect agglutination (a) Hepatitis (b) Pregnancy hCG Ag

Paper II Pharmaceutical Microbiology (Practicals)

1. Sterility testing methods for pharmaceutical products
2. Testing for sterilization equipment
3. Tests for disinfectants (Phenol coefficient/RWC)
4. Determination of antibacterial spectrum of drugs/antibiotics
5. Chemical assays for antimicrobial drugs
6. Testing for antibiotic/drug sensitivity/resistance
7. Determination of MIC valued for antimicrobial chemicals
8. Microbiological assays for vitamins/amino acids
9. Microbiological assays for antibiotics (Liquid tube assay, agar tube assay, agar plate assays)
10. Toxicity tests in lab animals; Pyrogenicity tests in lab animals

Outcome:- This Practical is to help students develop the skills necessary for the critical analysis of contemporary literature on topics related to health and disease.

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SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Molecular Biology and Microbial Genetics

Course Code: 6SMMB301

Max. Marks: 50

Min. Marks: 17 COURSE

OBJECTIVE: the molecular mechanisms of DNA-replication, repair, protein synthesis.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Detailed structure of DNA, Z-DNA, A & B DNA, Denaturation and melting curves. Genome organization in prokaryotes and eukaryotes, Enzymes involved in DNA replication, Modes of DNA replication- Detailed mechanism of Semiconservative replication . Plasmids: nature, classification, properties and replication. Eukaryotic telomere and its replication.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Prokaryotic and eukaryotic transcription. Structure and processing of m-RNA, r-RNA t- RNA. Ribozyme, Genetic code and Wobble hypothesis, Translation in Prokaryotes and eukaryotes, Post translational modifications, Gene regulation and expression – Lac operon, arabinose and tryptophane operons, Gene regulation in eukaryotic systems, repetitive DNA, gene rearrangement, promoters, enhancer elements.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Types of mutagens, molecular basis of mutations, analysis of mutations, site directed mutagenesis and reverse genetics. Detailed mutagenesis and repair mechanism of UV, Ethidium Bromide and Nitrous oxide. DNA damage and repair mechanisms. Isolation and applications of mutants	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Transposable elements – Definition, detection of transposition in bacteria, types of bacterial transposons and applications of transposons. Bacterial Recombinations-Discovery, gene transfer, molecular mechanism, detection , efficiency calculation and application	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Bacterial transformation- Competency and resistance. Bacterial conjugation – Sex factor in bacteria, F and HFR transfer, linkage mapping . Bacterial transduction – transduction phenomenon, methods of transduction, co-transduction, generalized, specialized and abortive transduction, sex-ductions.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: This course should excite about basic science and its applications.

TEXT / REFERENCE - BOOKS:

- Molecular biology by Robert Weiver Molbio By Upadyaya
- Molecular biology by David and Freifelder
- Microbial genetics by David and Freifelder
- Genetics of bacteria and their viruses by William Hayes
- Molecular biology of thee gene by Watson et al
- The Lehninger Biochemistry
- Molecular biotechnology by Primerose
- Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 3rd
Course: M.Sc. Microbiology
SUBJECT: Industrial Microbiology

Course Code: 6SMMB302
Max. Marks: 50
Min. Marks: 17

COURSE OBJECTIVE: The course is designed to develop student's ability to apply the techniques used in the different phases of industrial microbiology.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Introduction to industrial microbiology. Definition, scope, history, microorganisms, properties and industrial products Screening for microbes of industrial importance. Primary screening, screening for amylase, organic acid, antibiotic, amino acid and vitamin producing microorganisms.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Secondary screening Further evaluation of primary isolates Detection and assay of fermentation products. Physico-chemical methods and biological assays. Fermentation equipment and its use. Design of fermenter, type of fermenter, agitation, aeration, antifoam, pH and temperature contro	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Inoculum media, inoculum preparation, Raw materials Saccharides, starchy and cellulosic materials Fermentation media and sterilization. Types of fermentations processes – Solid state, surface and submerged fermentation	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Batch, fed batch and continuous fermentations, Direct, dual or multiple fermentations.Scale-up of fermentations.Product recovery methods. Fermentation type reactions, alcoholic, lactic acid, mixed acid, propionic acid, butandiol and acetone-butanol types.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Strain development strategies. Environmental factors and genetic factors for improvement. Immobilization methods – Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME:encouraging students to appreciate the exploitation of microorganisms in industries as a viable alternative to the use of chemicals to the production of useful products.

TEXT / REFERENCE - BOOKS:

- Industrial Microbiology by Casida, LE
- Industrial Microbiology by Patel, AH
- Industrial Microbiology by Miller, BM and Litsky
- Industrial Microbiology by Prescott and Dunn
- Microbial Technology by Peppler, JH and Perlman, D.
- Biochemistry of Industrial Microorganisms, by Rainbow and Rose
- Economic Microbiology by Rose Vol I – V
- Microbial Enzymes and Biotechnology by Fogarty WM and Kelly, CT

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer,Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Lab (Molecular Biology & Industrial Microbiology)

Subject Code: 6SMMB313

Practical Max. Marks: 25

Practical Min. Marks: 08

Experiments based on the paper 1 (Molecular Biology & Microbial Genetics) & Paper 2 (Industrial Microbiology)

Objective:- The practical is designed to develop student's ability to apply the techniques used in the different phases of industrial microbiology

Molecular Biology and Microbial Genetics- Practicals

1. Isolation of genomic DNA from *E.coli* and Yeast.
2. Estimation of DNA, RNA and Protein (colorimetry)
3. Determination of molecular weight of DNA,
4. resolved on agarose gel electrophoresis Induction of enzymes – Lac operon
5. Determination of molecular weight of protein by PAGE
6. Induction of mutations by physical/chemical mutagens,
7. screening and isolation of mutants,
8. Replica plating technique Transformation in bacteria
9. Conjugation in bacteria Protoplast preparation, Fusion and regeneration

Industrial Microbiology (Practicals)

1. Screening for amylase producing organisms
2. Screening for organic acid producing microorganisms
3. Isolation of antibiotic producing microorganisms by crowded plate technique
4. Isolation and culturing of yeasts Separation of amino acids by chromatography
5. Estimation of glucose by DNS method
6. Estimation of ethanol by dichromate method
7. Estimation of maltose Immobilization of microbial cells by entrapment method

Outcome:- Encouraging students to appreciate the exploitation of microorganisms in industries as a viable alternative to the use of chemicals to the production of useful products.

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SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Environmental and Agricultural Microbiology (Elective – I) Min. Marks: 17

Course Code: 6SMMB303

Max. Marks: 50

COURSE OBJECTIVE: The study of the composition and physiology of microbial communities in the environment.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Microorganisms in air and their importance (brief account) Microorganisms and water pollution Water-borne pathogenic microorganisms and their transmission. Sanitary quality of water. Water pollution due to degradation of organic matter Aerobic sewage treatment – Oxidation ponds, trickling filters, activated sludge treatment Anaerobic sewage treatment – Septic tank	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Recalcitrant molecules, Bioremediation technologies: in situ and solid phase; ex situ and bioreactors Microbial remediation of metals, Molecular techniques in bioremediation Methods of enumeration and activity of microbes in environment Microbial biodegradation of organic pollutants. Degradation of carbonaceous materials in soil – cellulose, hemicellulose and lignin decomposition, factors governing the decomposition and biochemistry of decomposition, Soil humus formation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Nitrification – Microbes involved, factors influencing nitrification, nitrifying bacteria and biochemical mechanism. Denitrification – microbes involved, factors influencing and the mechanism of denitrification and nitrate pollution. Nitrogen fixation – Asymbiotic and symbiotic nitrogen fixation, microorganisms involved, biochemistry and genetics of nitrogen fixation, measurement of nitrogen fixation ecological and economic importance of nitrogen fixation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Biofertilizers – biological nitrogen fixation – nitrogenase enzyme – symbiotic nitrogen fixation- (Rhizobium, Frankia) – non symbiotic nitrogen fixation (Azotobacter - Azospirillum), VAM- ecto- endo-ectomycorrhizae and their importance in agriculture. Biopesticides: toxin from Bacillus thuringiensis, Psuedomonassyringae. Biological control - use of Baculovirus, protozoa and fungi.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	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).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: Students will understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

TEXT / REFERENCE - BOOKS:

- Soil Microbiology by Alexander Martin
- Microbial ecology, Fundamentals and Applications Ed. Benjamin-Cummings
- Environmental Biotechnology-Fundamentals and applications. By Parihar (Agrobiosindia – publishers)
- Soil Microbiology by Singh, Purohit, Parihar published by student edition.
- Soil Biotechnology by JM Lynch
- Microbial Ecology: Organisms, Habitats, and Activities by Stolp, H.
- Soil Microbiology and Biochemistry by Paul E. and PE Clank
- Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul
- Biological Nitrogen Fixation by Quispel
- Soil Microorganisms and Plant Growth by N.S., Subba Rao.
- Laboratory experiments in microbiology by Gopal Reddy et al

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Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER-3rd

Subject Code: 6SMMB314

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: The study of the composition and physiology of microbial communities in the environment.

Environmental and Agricultural Microbiology (Practicals)

1. Isolation and observation of air microflora
2. Enumeration of soil microorganisms (bacteria, actinomycetes, fungi) by standard plate count
3. Estimation of soil microbial activity by CO₂ evolution
4. Isolation of cellulose decomposing microbes and estimation of cellulose activity
5. Isolation of Cyanobacteria from peddy field.
6. Measurement of pH of soil sample.
7. Estimation of ammonifiers, nitrifiers and denitrifiers in soil by MPN METHOD
8. Isolation and culturing of Rhizobium sp from root nodules and Azospirillum from grasses (Cyanodon)
9. Biological enrichment isolation of Rhizobium from soil by Leonard Jar experiment
10. Nodulation testing by tube/jar method
11. Observation and assessment of soil algae/algal biofertilizers
12. Estimation of N₂ fixation (Micro Kjeldahl method/GC method)
13. Estimation of BOD Testing for microbial sanitary quality of water (coliform test)
14. Bioremediation-in-situ, solid phase and bioreactors
15. Isolation and observation for phyllospheremicroflora
16. Isolation and observation for rhizospheremicroflora
17. Observation for Mycorrhizae Effect of pesticides on microbial activity

COURSE OUTCOME: Students will understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

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SEMESTER- 3rd
Course: M.Sc. Microbiology
SUBJECT: Soil Microbiology (Elective – I)

Course Code: 6SMMB402
Max. Marks: 50
Min. Marks: 17

COURSE OBJECTIVE: soil microbiology is the study of microorganisms in soil, their functions, and how they affect soil properties.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Microbes in the terrestrial environment- general characteristic of porous media, distribution of microbes in different soil zones and their metabolic states, role of microbes in surface soil formation, nutrients cycling, soil pathogens and diseases in plant and human.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Microbial metabolism- conversion of light energy into chemical bond energy- photosystems I & II. Production of ATP cyano-bacteria and green algae. Role of bacterio- chlorophyll phycocyanin, phycoerythrin and carotenoids in photosynthetic bacteria and chlorophyll in green algae. Photosynthesis in anaerobic and sulphur bacteria. Requirement of ATP, O ₂ - sensitivity and inhibition by ammonia and nitrogenous substance in the case of nitrogenase, the peculiarity of alternate nitrogenase of streptomyces thermoautotrophicus.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Biofertilizer- biological nitrogen fixation- symbiotic and asymbiotic, mass production by rhizobium, azotobacter and cyanobacteria, nitrifying ammonifying and photosynthetic bacteria, denitrification of nitrate fertilizers to N ₂ and N ₂ O (a green house gas) by denitrifying bacteria, free living and in association with azolla, phosphate solubilizing bacteria. Soil anaerobic methanogens in rice field, effect of soil pH and heavy metals on microorganisms, microbial antagonism in soil, biological control of soil- borne microbial pathogens.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Application of recombinant microorganisms in agriculture- agrobacterium and virus mediated gene transfer and improvements of crops microorganism and agriculture- functions of microorganisms: putrefaction, fermentation, and synthesis, relationships between putrefaction, fermentation and synthesis of biomolecules classification of soils based on the function of microorganisms (disease-inducing soils, disease- suppressive soils, zymogenic soils, synthetic soils), controlling the soil microflora for optimum crop production and protection.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Eco-friendly microbes and their utilization- utilization of beneficial microorganisms in agriculture, ice minus bacteria and microbial pesticides.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: the student will own knowledge on the role of beneficial microorganisms in the transformation of organic matter, biogeochemical cycles, and in biological soil fertility.

TEXT / REFERENCE - BOOKS:

- Polar microbiology by Robert v. miller, lylewhyte
- Bacterial metabolism by H.W. Doelle
- Microbial biofertilizer by mahendra rai
- Biofertilizer and organic farming by H. Panda
- Recombinant DNA by james D. Watson, Michael gilman, Watson, che
- Microbial biotechnology in agriculture and aquaculture by R.C. Ray, taylor&francis
- Plant, soil & microbes by Khalid rehmanhakeem, mohdsayedakhtar, sitinorakmar Abdullah

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Lab (Soil Microbiology)

Subject Code: 6SMMB402

Practical Max. Marks: 25

Practical Min. Marks: 08

Objective:- soil microbiology is the study of microorganisms in soil, their functions, and how they affect soil properties.

SOIL MICROBIOLOGY

1. Isolation of bacteria from soil.
2. Occurrence of arthropods in soil.
3. Examination of soil protozoa.
4. Examination and estimation of soil algae by the most probable number method.
5. Qualitative examination of soil micro-flora by Buried slide method.
6. Enumeration of bacteria by direct microscopic count.

Outcome:- Students will understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Bioenergetics and Molecular

Enzymology (Elective-I)

Subject Code: 6SMMB305

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: Bioenergetics is a field in biochemistry and cell biology that concerns energy flow through living systems

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Carbohydrate catabolic pathways and microbial growth on C1 Compounds EMP, HMP, ED, Phosphoketolase pathway, TCA cycle, methylglyoxal bypass. Anaplerotic sequences, catabolism of different carbohydrates, glycerol metabolism, regulation of carbohydrate metabolism, Pasteur effect. Substrate level phosphorylation. Microbial growth on C1 Compounds (Cyanide, Methane, Methanol, methylated amines and carbon monoxide).	Usage of ICT (Powerpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Bacterial fermentations (biochemical aspects) and Biosynthesis Alcohol, lactate, mixed acid, butyric acid, acetone-butanol, propionic acid, succinate, methane, and acetate fermentations. Fermentation of single nitrogenous compounds [amino acids] -alanine, glutamate and glycine. Biosynthesis of Purines, Pyrimidines and fatty acids.	Usage of ICT (Powerpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Endogenous metabolism and degradation of aliphatic and aromatic compounds. Functions of endogenous metabolism, types of reserve materials, enzymatic synthesis, degradation and regulation of reserve materials - glycogen, polyphosphates and polyhydroxybutyrate (PHB), PHB production and its futuristic applications. Microbial degradation of aliphatic hydrocarbons (microorganisms involved, mon-terminal, bi-terminal oxidation of propane, decane, etc.) and aromatic hydrocarbons and aromatic compounds (via catechol, protocatechuate, meta-cleavage of catechol and protocatechuate, dissimilation of catechol and protocatechuate, homogentisate and other related pathways).	Usage of ICT (Powerpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Properties of Enzymes Classification of enzymes into six major groups with suitable examples. Numerical classification of enzymes. Different structural conformations of enzyme proteins. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site, theories of mechanisms of enzyme action. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. Monomeric, Oligomeric and multienzyme complex, isozymes and allosteric enzymes. Extremozymes - thermostable, solventogenic and non-aqueous enzymes. Ribozymes and abzymes	Usage of ICT (Powerpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Enzyme kinetics Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction.	Usage of ICT (Powerpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES:

Bioenergetics is a branch of biochemistry that studies the transformation of energy within living organisms, and between living organisms and their environment.

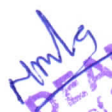
TEXT/REFERENCE BOOKS:

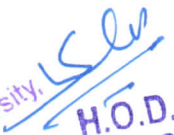
1. Understanding Enzymes by Trevor Palmer
2. Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York.
3. Enzymes by Dixon and Webb, 3rd Edition 1979. Academic Press, New York
4. Biochemistry by Stryer 5th Edition WH Freeman 2001
5. Laboratory techniques in Biochemistry and Molecular Biology by Work and Work.

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6. Principles of Enzyme Kinetics. 1976. By Athel Cornish - Bowden. Butterworth and Co.
7. Fundamentals of Enzymology. 3rd Edition by Price
8. Biochemistry by Chatwal

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (quality Education)	Service consultancy


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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER-3rd

Subject Code: 6SMMB305

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: Bioenergetics is a field in biochemistry and cell biology that concerns energy flow through living systems

PRACTICAL

BIOENERGETICS AND MOLECULAR ENZYMOLOGY

1. Isolation and Identification of Reserve food material (Glycogen / polyphosphates, PHB) of B. megaterium and Azotobacter SP.
2. Quantitative estimation of amino acids by Rosen's method.
3. Quantitative estimation of sugars by Summner's method.
4. Demonstration of endogenous metabolism in B megaterium or E. coli and their survival under starvation conditions
5. Quantitative estimation of proteins by Folin-Lowry / Biuret method.
6. Production of fungal alpha amylase using solid-state fermentation/ production of protease by bacterial species and confirmation by determining the achromic point.
7. Purification of fungal alpha-amylase or bacterial protease by fractionation, chromatographic techniques and electrophoretic separation.
8. Studies on enzyme kinetics of alpha amylase/Protease [Optimization of parameters viz.Substrate, enzyme concentration, reaction temperature, reaction pH, Km, Vmax and metal ions as activators and inhibitors).

COURSE OUTCOMES:

Bioenergetics is a branch of biochemistry that studies the transformation of energy within living organisms, and between living organisms and their environment

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Dr. C.V. RAMAN UNIVERSITY
Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Bioinstrumentation (Elective-I)

Subject Code:6SMMB305

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: The *objective* of this course is to introduce the students to the application of biomedical *instrumentation*.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Basic laboratory Instruments Principle and working of pH meter, Laminar-air flow. Centrifugation: Types of centrifugemachines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Chromatographic techniques Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity, hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC)	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Electrophoretic techniques Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Spectroscopy Spectroscopic techniques, theory and applications of Uv, Visible, IR, NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Radioisotopic techniques Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications. Dosimetry.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES:

The *Instrumentation* Technology certificate will develop entry-level skills in industrial *instrumentation*, maintenance and calibration.

TEXT / REFERENCE-BOOKS:

1. Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others. 1986. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (quality Education)	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Subject Code: 65MMB306

Course: M.Sc. Microbiology

Practical Max. Marks:25

Min.Marks:08

COURSE OBJECTIVE: The *objective* of this course is to introduce the students to the application of biomedical *instrumentation*.

PRACTICAL

BIOINSTRUMENTATION

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. Separation of serum protein by horizontal submerged gel electrophoresis.
4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
5. Quantitative estimation of hydrocarbons/pesticides/organic Solvents /methane by Gas chromatography.
6. Demonstration of PCR, DNA sequencer and Fermenter.
7. Separation of haemoglobin or blue dextran by gel filtration.
8. Paper electrophoresis.
9. Friskedosimetry.

COURSE OUTCOMES:

The *Instrumentation* Technology certificate will develop entry-level skills in industrial *instrumentation*, maintenance and calibration.

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER-3rd

Course: M.Sc. Microbiology

SUBJECT: Microbial Physiology(Elective-I)

Subject Code: 6SMMB306

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: In this course, students will be given the opportunity to learn about the following: **Bacterial** taxonomy and diversity.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Bacterial photosynthesis Photosynthetic microorganisms, photosynthetic pigments, and generation of reducing power by cyclic and non-cyclic photophosphorylation, electron transport chain in photosynthetic bacteria. Carbon dioxide fixation pathways.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Bacterial Respiration Bacterial aerobic respiration, components of electron transport chain, free energy changes and electron transport, oxidative phosphorylation and theories of ATP formation, inhibition of electron transport chain. Electron transport chain in some heterotrophic and chemolithotrophic bacteria. Bacterial anaerobic respiration: Introduction. Nitrate, carbonate and sulfate as electron acceptors. Electron transport chains in some anaerobic bacteria. Catalase, super oxide dismutase, mechanism of oxygen toxicity.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Bacterial Permeation Structure and organization of membrane (Glyco-conjugants and proteins in membrane systems), fluid mosaic model of membrane. Methods to study diffusion of solutes in bacteria, passive diffusion, facilitated diffusion, different mechanisms of active diffusion (Proton Motive Force, PTS, role of permeases in transport, different permeases in E. coli. Transport of aminoacids and inorganic ions in microorganisms and their mechanisms.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Bacterial Sporulation Sporulating bacteria, molecular architecture of spores, induction and stages of sporulation, Influence of different factors on sporulation. Cytological and macromolecular changes during sporulation. Heat resistance and sporulation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	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 <i>Hydrogenomonas</i> species. Ferrous and sulfur/sulfide oxidation by <i>Thiobacillus</i> species.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: Learning *outcomes* and competences: After the course the participants should be able to: Describe the metabolic and *physiological* diversity among prokaryotes.

TEXT/REFERENCE-BOOKS:

1. Microbial Physiology and Metabolism by Caldwell D.R. 1995 Brown Publishers.
2. Microbial Physiology by Moat A.G. and Foster J. W. 1999.. Wiley.
3. . Prokaryotic Development by Brun. Y.V. and Shimkets L.J. 2000. ASM Press.
4. Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.
5. Applied Microbial Physiology by Rhodes.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (quality Education)	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course:M.Sc. Microbiology

Subject Code: 6SMMB307

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: In this course, students will be given the opportunity to learn about the following: *Bacterial* taxonomy and diversity.

PRACTICAL

MICROBIAL PHYSIOLOGY

1. Isolation of Photosynthetic bacteria
2. Glucose uptake by *E. coli* / *Saccharomyces cerevisiae* [Active and Passive diffusion]
3. Effect of UV, gamma radiations, pH, disinfectants, chemicals and heavy metal ions on spore germination of *Bacillus* SP.
4. Determination of Iron Oxidation Rate of *Thiobacillusferrooxidans*.
5. Determination of Sulfur Oxidation Rate of *Thiobacillusthiooxidans*.
6. Microbial degradation, decolorization and adsorption of organic dyes (by free and immobilized cells).
7. Estimation of calcium ions present in sporulating bacteria by EDTA method.
8. Demonstration of utilization of sugars by oxidation and fermentation techniques.

COURSE OUTCOMES: Learning *outcomes* and competences: After the course the participants should be able to: Describe the metabolic and *physiological* diversity among prokaryotes.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Medical Microbiology (Elective - II)

Course Code: 6SMMB308

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: Develops basic skills necessary to work in the microbiology laboratory.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Principles of Medical Microbiology: Classification of medically important microorganisms. Normal flora of human body – Origin of normal flora, factors that influences normal flora, role of the resident flora, effect of antimicrobial agents on normal flora, characteristics of normal flora .	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Distribution and occurrence of normal flora (Skin, conjunctiva, nose, nasopharynx, sinuses, mouth, upper respiratory tract, intestinal tract, urogenital tract) Bacteria in the blood and tissues. Properties of pathogenic microorganisms. Factors that influence pathogenicity Type of infections, source of infections, different modes/means of infections .	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Diagnostic microbiology – Types of specimen, specimen collection, transportation of specimen, processing, laboratory investigations, specific lab. Tests, non-specific lab tests, diagnosis and report. Use of lab animals in diagnostic microbiology.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following bacterial pathogens. Bacterial air borne infections – B-Haemolytic streptococci, Pneumococci, Corynebacterium diphtheriae, Mycobacterium tuberculosis, Mycobacterium leprae, Neisseria meningitidis, haemophilus influenzae. Sexually transmitted diseases caused by bacteria, Treponema pallidum, Neisseria gonorrhoea.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Systematic bacteriology – Detailed study of morphology, cultural characteristics, antigenic structure, pathogenesis, diagnostic lab tests (conventional and molecular), epidemiology, prevention and treatment of the following pathogenic bacteria: Water borne infections – E.coli, Salmonella typhi, Shigella dysenteriae, Vibrio cholerae. Wound infections – Staphylococcus aureus, Clostridium tetani, Clostridium welchi, Pseudomonas.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: The student will be able to identify common infectious agents and the diseases that they cause. **TEXT / REFERENCE - BOOKS:**

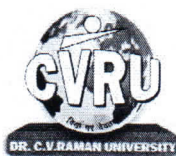
- Review of Medical Microbiology by Jawitz, Melnick and Adelberg
- Diagnostic Microbiology by Bailey and Scott
- Medical Microbiology by Cruickshank et al Vol I & II
- Text book of Microbiology by Ananthanarayanan and Jayaram Paniker

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Subject Code: 65MMB308

Course: M.Sc. Microbiology

SUBJECT: Lab (Medical Microbiology)

Practical Max. Marks: 25

Practical Min. Marks: 08

COURSE OBJECTIVE: Develops basic skills necessary to work in the microbiology laboratory.

Medical Microbiology (Practicals)

1. Preparation of different types of culture media/observation. Blood Agar, Chocolate Agar, Mannitol salt agar, Blair Parker medium, MacConkey agar, Lowenstein-Jensen medium, Wilson Blair Bismuth sulphite medium, Biochemical media.
2. Staining techniques – Gram's staining, AFB staining, Albert Staining, Capsular staining
3. Isolation and identification of various pathogenic bacteria by microscopic,
4. macroscopic, biochemical, enzymatic and serological tests (Coagulase, catalase, WIDAL, VDRL tests.)
5. Examination of pathogenic bacteria / permanent slides.
6. Bacteriological examination of urine, pus, throat swab etc from patients for diagnosis.
7. PCR based diagnosis.

COURSE OUTCOME: The student will be able to identify common infectious agents and the diseases that they cause.

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Applied Microbiology (Elective – II)

Course Code: 6SMMB309

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: The main objective of the course is to provide students with the basis to face the study of the major fundamentals of microbiology. The main knowledge provided will be microbiological techniques to be applied in the laboratory

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Microbial Products: - Application of microbial biotechnology, production of primary and secondary metabolites of industrial significance, A brief discussion about production of industrial products such as Fuels: Ethanol, Methane Alcoholic beverages: Beer, Wine.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Organic acids: Citric acid, Lactic acid Antibiotics: Penicillin, Streptomycin Amino acids: Glutamic acid, Lysine Enzymes: Protease, Amylase and Lipases	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Bioconversions: A brief account of steroid biotransformation. Microbial Foods: Single cell proteins. Sewage waste water treatment: Technique and plants. Biogas production	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Biodegradation of xenobiotic compounds. Microbial technology in agriculture- Bioinsecticides, Bioherbicides, Biofungicides. Biotechnology of mushroom cultivation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Molecular principles of drug targeting. Drug delivery system in gene therapy Bacterial resistance to antibiotics. Mode of action of bacterial killing by quinolinones. Bacterial resistance to quionolinones. Mode of action of non – antibiotic antimicrobial agents. Penetrating defenses – How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

- **COURSE OUTCOME:** Understand the beneficial role of microorganisms in fermented foods and in food processing and the microbiology of different types of fermented food products – dairy, pickles, Legume and cereal based food products
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in manufacture of industrial products

TEXT / REFERENCE - BOOKS:

- Aneja.K.R et al.: A Text book of Basic and Applied Microbiology, New Age International Publishers, New Delhi.
- Aneja.K.R and Mehrotra R.S.: Fungal Diversity & Biotechnology, New Age International Publishers, New Delhi.
- Waites M.J. et al.: Industrial Microbiology, Blackwell Science Ltd. Casida L.E: Industrial Microbiology, New Age International Publishers, New Delhi.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

**SUBJECT: Bioinformatics, Microbial
Genomics and Proteomics(Elective-II)**

Subject Code: 6SMMB310

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: *Bioinformatics objective* to enrich biological data and to apply computer based algorithm.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Bioinformatics and its applications Databases, types, pairwise and multiple alignments. Structure-function relationship. Sequence assembling using computers. Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA, GCC etc.) Search and retrieval of biological information and databases sequence, databank. (PDB and gene bank), accessing information (Network expasy, EMB Net, ICGB Net).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Whole genome analysis Preparation of ordered cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Sequence analysis Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Profile Scan). DNA analyses for repeats (Direct and inverted), palindromes, folding programmes. Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, GeneBank), database for protein structure (PDB).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	DNA Microarray Printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for Global patterns of gene expression using fluorescent-labelled cDNA or end labelled RNA probes. Analyses of single nucleotide polymorphism using DNA chips.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Proteome analysis Two dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by Mass Spectroscopy. Protein microarray advantages and disadvantages of DNA and protein microarrays	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: At the completion of the course, you should be able to Apply basic knowledge of the procedures used to assemble genomes, identify genes and predict their function.

TEXT / REFERENCE-BOOKS:

1. Bioinformatics. 1998 by Baxeavanis

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2. Bioinformatics 2000 by Higgins and Taylor OUP.
3. Nucleic acid Research 2001. Jan. Genome database issue.
4. The Internet and the new Biology: Tools for Genomics and Molecular Research by Peruski, Jr. and Peruske (ASM) 1997.
5. Functional Genomics. A Practical Approach Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.
6. DNA microarrays: A practical approach edited by Mark Schena (OUP)

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure)	Service consultancy


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 Dr. C.V. Raman University,
 Kota, Bilaspur,
 (C.G.), India


H.O.D.
 Deptt. of Life Sciences
 Dr. C.V. Raman University
 Kota, Bilaspur (C.G.)


Deputy Registrar (Academic)
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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

Subject Code: 6SMMB310

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: *Bioinformatics objective* to enrich biological data and to apply computer based algorithm

PRACTICAL

BIOINFORMATICS, MICROBIAL GENOMICS
AND PROTEOMICS.

Use of Internet/software for sequence analysis of nucleotides and proteins.

1. Studies of public domain databases for nucleic acid and protein sequences.
2. Determination of protein structure (PDB)
3. Genome sequence analysis

COURSE OUTCOMES: At the completion of the course, you should be able to Apply basic knowledge of the procedures used to assemble genomes, identify genes and predict their function.

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

SUBJECT: Bacteriology (Elective-II)

Subject Code: 6SMMB311

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: To recognize, identify and differentiate the internal and external structures of procaryotic and eukaryotic microbial cells.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Cell organization Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: Structure, formation, stages of sporulation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Bacteriological techniques Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Microscopy Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Growth and nutrition Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media <i>Physical methods of microbial control:</i> heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation <i>Chemical methods of microbial control:</i> disinfectants, types and mode of action	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Reproduction in Bacteria <i>Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate</i>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: Students who graduate with a Master of Science in Immunology and Microbiology will Obtain a significant knowledge on fundamental and advanced aspects of Microbiology.

TEXT / REFERENCE BOOKS:

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure)	Service consultancy

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd

Course: M.Sc. Microbiology

Subject Code: 65MMB311

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: To recognize, identify and differentiate the internal and external structures of procaryotic and eukaryotic microbial cells.

BACTERIOLOGY (PRACTICAL)

1. Preparation of different media: synthetic media BG-11, Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.

COURSE OUTCOMES: Students who graduate with a Master of Science in Immunology and Microbiology will Obtain a significant knowledge on fundamental and advanced aspects of Microbiology.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 3rd
Course: M.Sc. Microbiology
SUBJECT: Advances in Microbiology (Elective-II)

Subject Code: 6SMMB312
Theory Max. Marks: 50
Min. Marks: 17

OBJECTIVES: *Advances in Microbiology aims* to publish high quality papers in all areas of Microbiology

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Evolution of Microbial Genomes Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence – Genomic islands, Pathogenicity islands (PAI) and their characteristics	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Metagenomics Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Molecular Basis of Host-Microbe Interactions Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Systems and Synthetic Biology Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Biofuels Useful features of bio-fuels. The substrate digester and the microorganisms in the process of biogas production (biomethanation). Production of bioethanol from sugar, molasses, starch and cellulosic materials. Ethanol recovery. Microbial production of hydrogen gas, biodiesel from hydrocarbons.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: In spite of many *advances in microbiology* and bacteriology, there still remain many unanswered questions

TEXT / REFERENCE BOOKS:

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press
5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag
6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure)	Service consultancy

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SEMESTER- 3rd

Subject Code: 65MMB312

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVES: *Advances in Microbiology* aims to publish high quality papers in all areas of Microbiology

ADVANCES IN MICROBIOLOGY (PRACTICAL)

1. Extraction of metagenomic DNA from soil
2. Understand the impediments in extracting metagenomic DNA from soil
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers
4. Case study to understand how the poliovirus genome was synthesized in the laboratory
5. Case study to understand how networking of metabolic pathways in bacteria takes place

COURSE OUTCOMES: In spite of many *advances in microbiology* and bacteriology, there still remain many unanswered questions

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Mycology, Phycology & Protozoanology (Elective - III)

Course Code: 6SMMB401

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: mycology is the branch of biology concerned with the study of fungi, including their genetic and biochemical properties. Phycology is the scientific study of algae.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Mycology: General characters of fungi, substrate relationship in fungi, cell ultrastructure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic, symbiotic), heterothallism, heterokaryosis, parasexuality, recent trends in classification, phylogeny of fungi.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, with special reference to Pilobolus, Chaetomium, Morchella, Melampsora, Polyporus, Drechslera and Phoma; fungi in industry, medicine and as food, mycorrhizae, fungi as biocontrol agents	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Phycology: Algae in diversified habitats (terrestrial, fresh water, marine) thallus organization, cell ultrastructure, reproduction (vegetative, asexual, sexual) criteria for classification of algae: pigments, reserve food, flagella, modern classification	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Salient features of protochlorophyta, chlorophyta, charophyta, xanthophyta, Bacillariophyta, phaeophyta and Rhodophyta with special reference to Microcystis, Hydrodictyon, Chara, Draparnaldiopsis, Sargassum, Dictyota, Batrachospermum. Algal blooms, algal biofertilizers; algae as food, feed and use in industry.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Protozoanology: General characters of protozoa, Classification of Protozoa: Factors influencing Growth of Protozoa (Balanced growth, Non balanced growth) Ecology of free living Protozoa: (Marine Protozoa, Planktonic protozoa, Soil protozoa, Protozoan blooms) Nutrition in Protozoa: (Methods of feeding, Filter feeding, Raptorial feeding, Diffusion feeding, Digestion, Nutritional requirements) Metabolism in Protozoa: (Carbohydrate and Respiratory metabolism, Nitrogen metabolism, Lipid metabolism) Heredity in Protozoa.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: After completion of course the students will understand the general characters of fungi, algae and protozoan's economic importance and life cycle of various groups of algae fungi and protozoa. The students will understand the symbiotic and saprotrophic roles of fungi in agriculture and role of fungi as biocontrol agents and Mycorrhizal fungi as biofertilizer.

TEXT / REFERENCE - BOOKS:

- Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology, John Wiley & Sons Ind.
- Mehrotra, R.S. and Aneja, R.S. 1998. An Introduction to Mycology, New Age Intermediate Press.

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- S.B.Agrawal-unified text book for degree students,shivlal Agrawal and company.
- Bubey and maheshwari-0microbiology S. Chand and company.
- Singh pandey and Jain -Diversity of microbes and cryptogams-Rastogi Publications.
- Baker-parasitic protozoa.
- Chatterjee-parasitology.
- Hunter and LWaff-biochemistry and physiology of protozoa Vol.1,2&3

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer,Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Lab (Parasitology)

Subject Code: 65MMB304

Practical Max. Marks: 25

Practical Min. Marks: 08

COURSE OBJECTIVE: the purpose of this first laboratory is to introduce you to some of the techniques that a veterinarian uses to detect the eggs, cysts, and larvae of parasites in the feces of animals.

PARASITOLOGY

1. Isolation of micro-flora from human throat.
2. Identification of *staphylococcus aureus* by face typing.
3. Differentiation of streptococci by bile esculin test.
4. Urine culture and its microbiological analysis.
5. Determination of antibiotic peak levels attained in body fluids.

COURSE OUTCOME: students will be able to apply working knowledge of fundamental facts, concepts and theories about marine parasitology and disease

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SEMESTER- 4th
Course: M.Sc. Microbiology
SUBJECT: Microbial diversity and
Extremophiles (Elective-III)

Subject Code: 6SMMB403
Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: The *aim* of this work is to offer a short, but comprehensive report on the biology and *biodiversity*.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Biodiversity Introduction to microbial biodiversity – distribution, abundance, ecological niche. Types- Bacterial, Archaeal and Eucaryal.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Characteristics and classification of Archaeobacteria. Thermophiles: Classification, hyperthermophilic habitats and ecological aspects. Extremely Thermophilic Archaeobacteria, Thermophily, commercial aspects of thermophiles. Applications of thermozymes. Methanogens: Classification, Habitats, applications.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Alkalophiles and Acidophiles Classification, alkaline environment, soda lakes and deserts, calcium alkalophily Applications. Acidophiles: Classification, life at low pH, acidotolerance, applications.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Halophiles and Barophiles Classification, Dead Sea, discovery basin, cell walls and membranes – Purple membrane, compatible solutes. Osmoadaptation / halotolerance. Applications of halophiles and their extremozymes. Barophiles: Classification, high-pressure habitats, life under pressure, barophily, death under pressure.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Space Microbiology Aims and objectives of Space research. Life detection methods a) Evidence of metabolism (Gulliver) b) Evidence of photosynthesis (autotrophic and heterotrophic) c) ATP production d) Phosphate uptake e) Sulphur uptake. Martian environment (atmosphere, climate and other details). Antarctica as a model for Mars. Search for life on Mars, Viking mission, Viking landers, and Biology box experiment. Gas exchange, Label release and pyrolytic release experiments. Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, changes in mycological autoflora, and changes in bacterial autoflora.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOMES: At the end of the course, students will be able to Recognize the extent of *microbial diversity*

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TEXT / REFERENCE BOOKS:

1. Extremophiles by Johri B.N. 2000. Springer Verlag, New York
2. Microbial Diversity by Colwell, D. 1999, Academic Press.
3. Microbial Life in Extreme Environments. Edited by D. J. Kushner. Academic Press.
4. Microbiology of Extreme Environments. Edited by Clive Edwards. Open University Press. Milton Keynes.
5. Microbiology of Extreme Environments and its potential for Biotechnology. Edited by M.S. Da Costa, J.C. Duarte, R.A. D. Williams. Elsevier Applied Science, London.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry, Innovation and Infrastructure), Goal-12 (Responsible Consumption and Production), Goal-17 (Partnership for the Goals)	Service consultancy

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SEMESTER- 4th

Subject Code: 65MMB403

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: The *aim* of this work is to offer a short, but comprehensive report on the biology and *biodiversity*

PRACTICAL

MICROBIAL DIVERSITY AND EXTREMOPHILES

1. Isolation of thermophiles from hot water spring [Study at least one enzyme].
2. Studies on halophiles isolated from seawater. [Pigmentation and Salt tolerance]
3. Studies on alkalophiles isolated from lonar water/sea water. [Study at least one enzyme]
4. Biogenic methane production using different wastes.
5. Isolation of *Thiobacillusferrooxidans* and *Thiobacillusthiooxidans* cultures from metal sulfides, rock coal and acid mine waters.

COURSE OUTCOMES: At the end of the course, students will be able to Recognize the extent of *microbial diversity*

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SEMESTER-4th

Course: M.Sc. Microbiology

SUBJECT: Microbial Genetics (Elective-III)

Subject Code: 6SMMB404

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: To begin developing a strategy for placing significance on a *genetic* analysis of *microbial* forensic evidence and addressing the *objectives* of *microbial* forensics

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	DNA Structure and Mutagenesis Historical developments in genetics, discovery of DNA and experimental evidence, Structure of Circular DNA molecule, Primary, Secondary, Tertiary and Quaternary structure of DNA, Watson and Crick model of double stranded DNA the law of DNA constancy and C value paradox and topological manipulations. DNA replication: DNA replication mechanism, enzymes involved in DNA replication and models of DNA replication. Molecular basis of spontaneous and induced mutations [physical and chemical mutagenic agents], types of mutation: point, frameshift, lethal, conditional lethal, inversion and deletion, null mutation, reversion of mutations, intra and intergenic suppression mutations. Environmental mutagenesis, toxicity testing and population genetics. Systems that safeguard DNA. DNA methylation and DNA repair mechanisms - excision, mismatch, SOS ,photoreactivation, recombination repair and glycosylase system.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Prokaryotic Transcription and Translation Organization of transcriptional units and regulation of gene expression Mechanism of transcription of prokaryotes-Structure and function of RNA polymerase, [DNA foot printing], termination and antitermination – N proteins and nut sites in DNA binding proteins, enhancer sequences and control of transcription, RNA processing (Capping, polyadenylation, splicing, introns and exons) Ribonucleoprotein, structure of mRNA, rRNA, tRNA. Direction of protein synthesis, RNA template, direction with experimental proof, tRNA as adaptor, ribosomes and their organization in prokaryotes, polycistronic mRNA in bacteria, initiation of translation in bacteria, small sub-units, its accessory factors, SD sequence in bacteria, initiator tRNA, elongation of translation, translocation and termination mechanisms. Post-translational modification. Salient features of genetic code.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Regulation of gene expression in prokaryotes Operon concept, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA, positive regulation in E.coli [Arabinose operon] and negative regulation in E.coli [lac operon], inducers and repressors, regulation by attenuation by trp operon.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Genetic recombination <u>Genetic recombination processes</u> : Role of rec proteins in homologous recombination. Conjugation: Discovery, F+, F- and Hfr cells, types of Hfr, F+ and F- and Hfr and F- genetic crosses. Mechanism of conjugation. Sexduction, conjugational transfer of colicinogenic and resistance transfer factors. Genetic mapping. Plasmid Replication and Incompatibility, Control of copy number. Transposons – Insertion sequences and composite transposons.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

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	phages as transposons, replicative, non-replicative and conservative transposition. Mutations i.e. deletions, inversions and frameshift due to transposition. Mechanism of transposition, controlling elements of maize – autonomous and non-autonomous elements. Types of transposons and their properties.	
Unit-V	Phage Genetics T4 virulent phage: structure, life cycle, genetic map and DNA replication. Lamda temperate phage: Structure, genetic map, lytic and lysogenic cycle, lysogenic repression and phage immunity. [Lambda regulon] applications of phages in microbial genetics.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: On completion of the course, the student should be able to: explain the processes behind mutations and other *genetic*.

TEXT / REFERENCE BOOKS:

1. Microbial Genetics by Maloy ET. Al. 1994. Jones and Bartlett Publishers.
2. Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons.
3. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.
4. Molculat Biology of the Gene 4th Edition by J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. Inc. California.
5. Gene VII by Lewin Oxford University Press. 2000.
6. Bacterial and Bacteriophage Genetics. 4 th Editions by Birge.
7. Microbial Genetics by Frefielder. 4th Edition.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer,Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (quality Education)	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

Subject Code: 6SMMB404

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: To begin developing a strategy for placing significance on a *genetic* analysis of *microbial* forensic evidence and addressing the *objectives* of *microbial* forensics

PRACTICAL

MICROBIAL GENETICS

1. Purification of chromosomal / plasmid DNA and study of DNA profile:
 - * Confirmation of nucleic acid by spectral study.
 - * Quantitative estimation by diphenylamine test.
 - * DNA denaturation and determination of Tm and G+C content.
 - * Agarose gel electrophoresis of DNA.
2. Effect of UV radiations to study the survival pattern of E. coli/yeast. Repair mechanisms in E. coli/yeast (Dark and photoreactivation)
3. Isolation of antibiotic resistant mutants by chemical mutagenesis.
4. Ampicillin selection method for isolation of auxotrophic mutant.
5. Extraction and Purification of RNA from S. cerevisiae.
6. Studies on gene expression in E.coli with reference to lac operon.
7. Study of conjugation in E. coli.
8. Restriction digestion and agarose gel electrophoresis of DNA.
9. Generalized transduction in E. coli using P1 phage.

COURSE OUTCOMES: On completion of the course, the student should be able to: explain the processes behind mutations and other *genetic*.

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Subject Code: 6SMMB405

Course: M.Sc. Microbiology

Theory Max. Marks: 50

SUBJECT: Recombinant DNA Technology (Elective-III)

Theory Min. Marks: 17

COURSE OBJECTIVE: After interacting with this Learning Object, the learner will be able to, Recombinant DNA technology which came into existence in the 1970s, allows for genetic manipulation of organisms by incorporating DNA sequences from different sources into a single recombinant molecule. This revolutionary technology has opened up several applications in plant genomics and clinical research. üList out tools used for gene exploration. üUtilize the knowledge on creation of a genomic library

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Techniques and enzymes in genetic recombination Core techniques and essential enzymes used in recombination: restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase its activity and mode of action. Chemical synthesis of DNA. Restriction digestion, ligation and transformation.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Plasmids Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, PBR 322 – its construction and derivatives, single stranded plasmids, promoter probe vectors, runaway plasmid vectors. Bacteriophage lambda (l) as a vector: Essential features, organization of l genome, general structure, rationale for vector construction, improved l vectors, l gt series, l EMBL vectors, invitro packaging, cosmids, phasmids, filamentous phage vectors, l zap, l blue print vectors.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Specialized cloning strategies Expression vectors, promoter probe vectors, vectors for library construction, genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Miscellaneous applications of Genetically engineered micro organisms (GEMS) / genetically modified organisms (GMO's).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	PCR methods and Applications PCR methods and Applications DNA sequencing methods, Dideoxy and Chemical method. Sequence assembly. Automated sequencing.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Molecular mapping of genome Genetic and physical maps, physical mapping and map –based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome microdissection and microcloning, molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, varietal etc. animal trafficking and poaching: Germplasm maintenance, taxonomy and Biodiversity.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

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COURSE OUTCOMES: Sensitive *DNA* detection *techniques* available could detect the transgene

TEXT / REFERENCE BOOKS:

1. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
2. DNA Cloning: A Practical Approach by D.M. Glover and B.D. Hames, IRL Press, Oxford. 1995.
3. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
4. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.
5. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (quality Education)	Service consultancy

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Dr. C.V. RAMAN UNIVERSITY

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SEMESTER- 4th

Subject Code: 6SMMB405

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

Objective: This revolutionary technology has opened up several applications in plant genomics and clinical research. üList out tools used for gene exploration. üUtilize the knowledge on creation of a genomic library.

PRACTICAL

RECOMBINANT DNA TECHNOLOGY

1. Isolation of genomic DNA and its confirmation by southern blotting.
2. Isolation of plasmid DNA and its restriction digestion.
3. DNA sequencing by Sangers method / or other method.
4. DNA cloning using plasmid vectors and expression vectors.
5. RFLP analysis.
6. Isolation of poly-A + RNA
7. Amplification of DNA by PCR.

COURSE OUTCOMES: Sensitive *DNA* detection *techniques* available could detect the transgene

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Microbial Ecology(Elective – IV)

Course Code:6SMMB406

Max. Marks: 50

Min. Marks: 17

COURSE OBJECTIVE: Microbial ecology focus on life too small to be seen without the aid of a microscope including bacteria, virus and fungi.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Microbial classification and basics of microbial density. Five kingdom classification of microbes, definition of microbial diversity and mode of evolution; microbial phylogeny; structural diversity of microbes, physiological diversity of micro organisms; prokaryotic diversity; eukaryotic micro organisms, microbial taxonomy, phylogeny of archaea, extremophils, commercial uses of extremophols, microbial diversity and its applications in modern science.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Habits and Habitat: principles of microbial ecology nutrient acquisition, microbial competition and antagonism, environments and micro environments, association of microbes with eukaryotes, rumen micro flora, aquatic habitats: marine and fresh water, terrestrial habitats, key nutrient cycles: carbon, nitrogen and sulphur.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Application of microbial ecology: microbial bioremediation, bioleaching, biodegradation, biomining, succession of microbial communities in the decomposition of plant organic matter.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Microbial pathogenesis: virulence factors of pathogens, enzymes toxins(host specific and non specific), effect of pathogens on host physiological process(photosynthesis, respiration, cell membrane permeability, trnslocation of water and nutrients, plant growth and reproduction).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Concept of plant disease- Microbial plant disease, types of plant pathogens, pathogenecity, symptoms, economic losses, principles and practices involved in the management of plant diseases by different methods. Some important disease caused by fungi, phytopathogenic bacteria, phytoplasmias, viruses.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOME: Studing these tiny organisms and how they interact with their environment has yielded incredible achievements across a variety of scientific disciplines and shed light on how important microbes are to the ecosystem they inhabit.

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TEXT / REFERENCE - BOOKS:

- Microbial diversity: D colwd
- Microbial ecology: J.M.Lynch and N.J.Poole
- Microbial ecology: Atlas and Bartha
- Microbial Ecology: An evolutionary approach by J. Yaunarther
- Microbial Ecology by S.K. Dubey
- Aquatic microbial ecology by Paul F. Kemp.

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer,Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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SEMESTER- 4th

Subject Code: 6SMMB406

Course: M.Sc. Microbiology
SUBJECT: Lab (Microbial ecology)

Practical Max. Marks: 25
Practical Min. Marks: 08

Objective:-Microbial ecology focus on life too small to be seen without the aid of a microscope including bacteria, virus and fungi.

Microbial Ecology(Practicles)

- Isolation of Azospirillum/Rhizobium and detection of IAA produced by them.
- Detection of siderophore production by Azospirillum and Pseudomonas or any other suitable bacteria.
- Isolation and identification VAM fungi from angiosperm root.
- Study of phycobiont and mycobionts in lichen
- Isolation of phosphate solubilizing bacteria from soil and study of its effect on plant growth
- Isolation of Aflatoxin producing organism. Detection of Aflatoxin in food / culture
- Determination of BOD of waste water sample.

Outcome:-Studying these tiny organisms and how they interact with their environment has yielded incredible achievements across a variety of scientific disciplines and shed light on how important microbes are to the ecosystem they inhabit.

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SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Cell tissue & Organ culture (Elective – IV)

Course Code: 6SMMB407


Max. Marks: 50

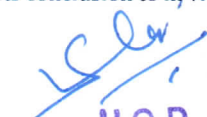
Min. Marks: 17

COURSE OBJECTIVE: The aim of cell, tissue and organ culture is to isolate at each level of organization the parts from the whole organisms for study in experimentally controlled environments populations of cells from monolayers or suspension cultures are used for nutritional, biochemical and immunological work.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Cell structure and methods in cell biology and functional organization, cell motility- ultrastructure and electron microscopy, fractionation of subcellular organelles , morphometry, cell counting.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Biomembrane and trans- membrane signaling. Biomembrane- structure, function relationship, Cell signaling- cell surface, hormone, receptors and singal transduction and second messengers.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Introduction to tissue culture techniques- definition, principle and significance of tissue culture, maintenance of sterility and use of antibiotic, mycoplasma and viral contaminants, culture media.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Animal cell organ culture- cell lines- definition, development, maintenance and management and cell adaptation, established cell lines- their characteristic features and utility, cross contamination hazards, organ culture: method, behavior of organ explants and utility of organ culture, mass production of biologically important compound.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	<p>Application of tissue culture- Commercial application of animal tissue culture: tissue culture as a screening system cytotoxicity and diagnostic tests, development and preparation of vaccines against infecting organisms, mammalian cloning.</p> <p>Commercial application of plant tissue culture for clonally identical plants: mass propagation by organogenesis and embryogenesis, synthetic seeds, use in multiplication of specific genotypes.</p>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.


COURSE OUTCOME: Cell, tissue and organ culture system: in vitro methods, their advantages and disadvantages conditions and level of their applications. The most important conditions and factors for in vitro survival, safety measures the analysis and evaluation of the results conclusion to in vivo processes.


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TEXT / REFERENCE - BOOKS:

- Plant Biotechnology: The Genetic Manipulation in Plants 2008 2ND (Ed) A. Slater, Scott N.W. and Fower M.R. Oxford press.
- An Introduction to Plant Tissue Culture, 2006 , 2nd 9 (Ed.) M.K. Razdan, Oxford and IBH Publishing
- Plant Tissue Culture: Theory & Practice, 1996, 2nd (Ed) S.S. Bhojwani and M.K. Razdan, Elsevier Health Sciences

Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure),	Service consultancy

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Lab (Cell Tissue & organ Culture)

Subject Code: 65MMB407

Practical Max. Marks:

Practical Min. Marks:

Objective:- The purpose of this first laboratory is to introduce you to some of the techniques that a veterinarian uses to detect the eggs, cysts, and larvae of parasites in the feces of animals.

Cell, tissue and organ culture(Practicles)

- Preparation of Cultured Cells for Electron Microscopy.
- Isolation and Identification of Human Viruses.
- The Application of Environmental Control to Continuous Culture and Vaccine Production.
- Animal and Plant Tissue Culture Decontamination.
- Consideration of Electrolytes and Nutritional Components for the Propagation of Obligate Intracellular Agents in Cell Cultures.
- Techniques for in Vitro Cultivation of Erythrocytic and Exoerythrocytic States of Malarial Parasites.
- Biological Control of Insect Pests with Viruses.

Outcome:- Cell, tissue and organ culture system: in vitro methods, their advantages and disadvantages conditions and level of their applications

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Biomathematics (Elective-IV)

Subject Code: 6SMMB408

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVE: To gain an insight into modelling techniques and principles in gene regulation, virus growth, cancer and physiology; to consolidate basic mathematical techniques used in these approaches, such as ODEs, PDEs, probability theory, branching processes and Markov Chains.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Biomathematics Sets. Functions and their graphs : polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibres etc. Simple observations about these functions like increasing, decreasing and, periodicity. Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Intuitive idea of algebraic relationships and convergence.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-II	Infinite Geometric Series. Series formulas for \exp , $\log(1+x)$, $\sin x$, $\cos x$. Step function. Intuitive idea of discontinuity, continuity and limits. Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-III	Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation. Integrals of the functions introduced above. Differential Equations of first order, Linear Differential Equations. Points in plane and space and coordinate form. Examples of matrices arising in Biological Sciences and Biological networks. Sum and Produce of matrices upto order 3.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-IV	Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences; Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions; Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics;	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.
Unit-V	Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom; Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test; Basic introduction to Multivariate statistics, etc.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) and field work/training as per requirement of the topic.

COURSE OUTCOMES: This course uses *mathematics* to solve biological and biomedical problems.


TEXT / REFERENCE BOOKS:

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : Introduction to Mathematics for Life Scientists, Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc;

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Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education), Goal-09 (Industry Innovation and Infrastructure), Goal-12 (Responsible Consumption and Production)	Service consultancy


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SEMESTER- 4th

Subject Code: 65MMB408

Course: M.Sc. Microbiology

Practical Max. Marks: 25

Min.Marks:08

COURSE OBJECTIVE: To gain an insight into modelling techniques and principles in gene regulation, virus growth, cancer and physiology; to consolidate basic mathematical techniques used in these approaches, such as ODEs, PDEs, probability theory, branching processes and Markov Chains.

BIOMATHEMATICS AND BIOSTATISTICS (PRACTICAL)

1. Word Problems based on Differential Equations
2. Mean, Median, Mode from grouped and ungrouped Data set
3. Standard Deviation and Coefficient of Variation
4. Skewness and Kurtosis
5. Curve fitting
6. Correlation
7. Regression
8. Finding area under the curve using normal probability
9. Testing of Hypothesis- Normal Distribution, t-test and Chi-Square-test
10. Confidence Interval

COURSE OUTCOMES: This course uses *mathematics* to solve biological and biomedical problems.

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SEMESTER-4th

Course: M.Sc. Microbiology

SUBJECT: Inheritance Biology (Elective-IV)

Subject Code: 6SMMB409

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVES: *Genetics* is the study of genes passed from parents to offspring.

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Introduction to Genetics Historical developments Model organisms in genetic analyses and experimentation: <i>Escherichia coli</i> , <i>Saccharomyces cerevisiae</i> , <i>Neurospora crassa</i> , <i>Caenorhabditis elegans</i> , <i>Drosophila melanogaster</i> , <i>Arabidopsis thaliana</i>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Mendelian Principles Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	Linkage and Crossing over Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Extra-Chromosomal Inheritance Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in <i>Chlamydomonas</i> , mitochondrial, mutations in <i>Saccharomyces</i> , Maternal effects - Shell coiling in <i>Limnaea peregrina</i> Infectious heredity - Kappa particles in <i>Paramecium</i>	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Characteristics of Chromosomes Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: On Completion of the course the students will be able to To gain knowledge about the organellar inheritance.

..TEXT / REFERENCE BOOKS:


1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H. Freeman and Co., New York

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Job Opportunities	Employability Skill developed	Local/National/UNDP Goal Achieved	Entrepreneurship Opportunity
Lecturer, Scientist, Researcher, entrepreneur, Consultant, etc.	Developing commercial awareness, able to understand and manage competition, able to plan different course of action.	Goal-04 (Quality Education),	Service consultancy


DEAN
 Faculty of Sciences
 Dr. C.V. Raman University
 Kota, Bilaspur
 (C.G.), India


 Deputy Registrar (Academic)
 Dr. C.V. Raman University
 Kota, Bilaspur (C.G.)





Dr. C.V. RAMAN UNIVERSITY

Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Subject Code: 65MMB409

Course: M.Sc. Microbiology

Practical Max. Marks: 25

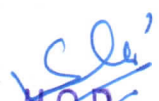
Min.Marks:08

COURSE OBJECTIVES:*Genetics* is the study of genes passed from parents to offspring.


INHERITANCE BIOLOGY (PRACTICAL)

1. Mendelian deviations in dihybrid crosses
2. Studying Barr Body with the temporary mount of human cheek cells
3. Studying *Rhoeo* translocation with the help of photographs
4. Karyotyping with the help of photographs
5. Chi-Square Analysis
6. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas* / *Drosophila* larvae
7. Study of pedigree analysis
8. Analysis of a representative quantitative trait

COURSE OUTCOMES: On Completion of the course the students will be able to To gain knowledge about the organellar inheritance.


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SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Biosafety and Intellectual Property Rights (Elective-IV)

Subject Code: 6SMMB410

Theory Max. Marks: 50

Theory Min. Marks: 17

COURSE OBJECTIVES: regulate research and development activities using recombinant DNA technology should be to minimize risk from such activities and at the same time encourage these activities

Units	Unit Wise Course Contents	Methodology Adopted
Unit-I	Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-II	Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-III	AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions.	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-IV	Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.
Unit-V	Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner	Usage of ICT (Powrpoint, PDF and video lectures) and black board (traditional) as per requirement of the topic.

COURSE OUTCOMES: One *outcome* of this workshop was that scientists and government Unfortunately, drafting *IPR* legislation and *biosafety* guidelines

TEXT / REFERENCE BOOKS:

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson

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Kargi Road, Kota, Bilaspur (C.G.)

SEMESTER- 4th

Subject Code: 65MMB410

Course: M.Sc. Microbiology

Practical Max. Marks: 25
Min.Marks:08

COURSE OBJECTIVES:regulate research and development activities using recombinant DNA technology should be to minimize risk from such activities and at the same time encourage these activities.

BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL)

1. Study of components and design of a BSL-III laboratory
2. Filing applications for approval from biosafety committee
3. Filing primary applications for patents
4. Study of steps of a patenting process
5. A case study

COURSE OUTCOMES:One *outcome* of this workshop was that scientists and government Unfortunately, drafting *IPR* legislation and *biosafety* guidelines

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SEMESTER- 4th

Course: M.Sc. Microbiology

SUBJECT: Project Work

Subject Code: 6PRSC401

Practical Max. Marks: 100


Practical Min. Marks: 33

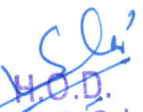
Objective: To prepare the students with basic knowledge in clinical immunology, biochemical techniques in order to continue their career in higher degree.


PROJECT

All the candidates of M.Sc.(Microbiology) are required to submit a project-report based on the work done by him/her during the project period. A detailed Viva shall be conducted by an external examiner based on the project report. Students are advised to see the detailed project related guidelines on the website of CVRU. (www.cvrु.ac.in) under Project Guidelines for student section.

Outcome: students have wide range of options for the occupation in the field of microbiology including: microbial physiology, microbial genetics, microbial ecology, pathogenesis, immunology, virology, evolution, diversity etc.


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