UNIVERSITY OF KERALA

COURSE STRUCTURE AND SYLLABUS

FOR

FIRST DEGREE PROGRAMME

IN

MICROBIOLOGY

UNDER

CHOICE BASED CREDIT- SEMESTER SYSTEM

(w.e.f. 2014 admission)

THE PROGRAMME

The programme is named as Bachelor of Science (B. Sc.) in Microbiology

ELIGIBILITY FOR ADMISSION

A pass in 10+2 (Higher Secondary/ISC/CBSE) Exam with Biology as one of the papers will be eligible.

OBJECTIVES OF THE PROGRAMME

• To impart knowledge of Science is the basic objective of education.

• To develop scientific attitude is the major objective to make the students open minded, critical & curious.

• To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.

• To understand scientific terms, concepts, facts, phenomenon and their relationships.

• To make the students aware of natural resources and environment.

• To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.

• The students are expected to acquire knowledge of microbiology and related subjects so as to understand natural phenomenon, manipulation of nature and environment in the benefit of human beings.

• To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.

• To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.

• To enrich the students with the latest developments in the field of Information Technology, Biotechnology, Bioinformatics and other related fields of research and development

• To create enthusiasm to understand more about the beautiful planet Earth and to give awareness to the public the need to protect the planet from all kinds of exploitation

• To keep the scientific temper which the student acquired from school level and to develop a research culture.

Table 1. General Structure of the First Degree Programme in Microbiology

Sem No	Course Code	Course Title	Instructional Hours/week		Credits	Uty Exam Duration	Evaluation		Total Credits
			L	P			Internal	Uty Exam	
I	EN 1111	English Language I	5	-	4	3			
	….1111	Additional Language I	4	-	3	3			
	EN1121	Foundation Course I	4	-	2	3			
	MB1141	Core Course I	3	1	3	3	25%	75 %	16
	CH1131	Complementary Course I*	2	2	2	3			
	BT 1131	Complementary Course II**	2	2	2	3			
II	EN 1211	English Language II	5	-	4	3			
	EN1212	English Language III	4	-	3	3			
	1211	Additional Language II	4	-	3	3			
	MB 1221	Foundation Course II	3	1	3	3	25%	75 %	17
	CH 1231	Complementary Course III	2	2	2	3			
	BT 1231	Complementary Course IV	2	2	2	3			
III	EN 1311	English Language IV	5	-	4	3			
	1311	Additional Language III	5	-	4	3			
	MB 1341	Core Course II	3	2	3	3	25%	75 %	17
	CH1331	Complementary Course V	3	2	3	3			
	BT 1331	Complementary Course VI	3	2	3	3			
IV	EN1411	English Language V	5	-	4	3			
	1411	Additional Language IV	5	-	4	3			
	MB1441	Core Course III	3	2	3	3			
	CH1431	Complementary Course VII	3	2	3	3			
	BT1431	Complementary Course VIII (CH/BT)	3	2	3	3	25%	75 %	25
	CH1432	Complementary Course IX (Practical)	-	(8)*	4	3			
	BT1432	Complementary Course X. (Chemistry/Biotechnology Practical)	-	(8)*	4	3			
V	MB1541	Core Course IV	4	3	4	3			
	MB1542	Core Course V	4	2	3	3			
	MB1543	Core Course VI	5	2	4	3			
	MB1544	Core (Practical- 1) VII	-	(5)*	3	3			
	MB1545	Core (Practical- 2) VIII	-	(5)*	4	3	25%	75 %	20
		Open Course I	3	-	2	3			
	MB1551.1	Mushroom Culture							
	MB1551.2	Microbial Waste Management							
	MB1551.3	Biofertilizer Technology							
		Project	-	2	-				
VI	MB1641	Core Course IX	4	3	4	3			
	MB1642	Core Course X	4	2	4	3			
	MB1643	Core Course XI	4	2	4	3			
	MB1644	Core (Practical 3) XII	-	(5)*	3	3			
	MB1645	Core (Practical 4) XIII	-	(4)*	4	3	25%	75 %	**75**
	MB1661	Elective Course	3	-	2	3			
	MB1646	Project	-	3	4	3			
									120

*** CH-Chemistry –Same syllabus of complementary Chemistry offered for Botany/Zoology may be followed**

**** BT-Biotechnology- New syllabus**

Table 2. Semester I

Course Code	Course Title	Instructional hours/week		Credits	Univ. Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ Exam	
EN 1111	English Language I	5		4	3 Hrs	25%	75%	16
….1111	Additional Language I (Hindi/Malayalam)	4		3				
EN1121	Foundation Course I	4		2				
MB 1141	Core Course I Methodology and Perspectives of Science.	3	1	3				
CH 1131	Complementary Course I (Chemistry- I)	2	2	2				
BT 1131	Complementary Course II (Biotechnology I)	2	2	2				

Table 3. Semester II

Course Code	Course Title	Instructional hours/week		Credits	Univ Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ Exam	
EN 1211	English Language II	5		4	3 Hrs	25%	75%	17
EN1212	English Language III	4		3				
1211	Additional Language II (Hindi/Malayalam)	4		3				
MB 1221	Foundation Course II General informatics and Bioinformatics	3	1	3				
CH 1231	Compl. Course III (Chemistry -II)	2	2	2				
BT 1231	Complementary Course IV (Biotechnology II)	2	2	2				

Table 4. Semester III

Course Code	Course Title	Instructional hours/week		Credits	Univ. Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ. Exam	
EN 1311	English Language IV	5		4	3 Hrs	25%	75%	17
1311	Additional Language III (Hindi/Malayalam)	5		4				
MB 1341	Core Course II Fundamentals of Microbiology	3	2	3				
CH 1331	Complementary Course V (Chemistry -III)	3	2	3				
BT 1331	Complementary Course VI (Biotechnology III)	3	2	3				

Table 5. Semester IV

Course Code	Course Title	Instructional hours/week		Credits	Univ. Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ. Exam	
EN 1411	English Language V	5		4	3 Hrs	25%	75%	25
1411	Additional Language IV (Hindi/Malayalam)	5		4				
MB 1441	Core Course III Microbial Genetics & Immunology	3	2	3				
CH 1431	Compl. Course V (Chemistry -IV)	3	2	3				
BT 1431	Complementary Course VII (Biotechnology IV)	3	2	3				
CH 1432	Complementary Course VIII (Chemistry Practical)		(8)*	4				
BT 1432	Complementary Course IX Practical (Biotechnology)		(8)*	4				

Table 6. Semester V

Course Code	Course Title	Instructional hours/week		Credits	Univ. Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ. Exam	
MB 1541	Core Course IV Instrumentation in Microbiology	4	3	4	3 Hrs	25%	75%	20
MB 1542	Core Course V Environmental Microbiology	4	2	3				
MB 1543	Core Course VI Medical Microbiology & Molecular Biology	5	2	4				
MB 1544	Core Course VII Practical (Instrumentation in Microbiology & Environmental Microbiology)		(5)*	3				
MB 1545	Core Course VIII Practical (Medical Microbiology & Molecular Biology)		(5)*	4				
MB 1551.1 MB 1551.2 MB 1551.3	Open Course – I Mushroom Culture Microbial Waste Management Bio-fertilizer Technology	3		2				
	Project		2					

Table 7. Semester VI

Course Code	Course Title	Instructional hours/week		Credits	Univ. Exam Duration	Evaluation		Total Credits
		L	P			Internal	Univ. Exam	
MB 1641	Core Course IX Industrial Microbiology	4	3	4	3 Hrs	25%	75%	25
MB 1642	Core Course X Bioinformatics & Biostatistics	4	2	4				
MB 1643	Core Course XI Food & Dairy Microbiology	4	2	4				
MB 1644	Core Course XII Practical (Industrial Microbiology & Food & Dairy Microbiology)		(5)*	3				
MB 1645	Core Course XIII Practical (Bioinformatics & Biostatistics)		(4)*	4				
MB 1661.1	Elective Course Biosafety in Microbiology	3		2				
MB 1646	Project		3	4				

L = Lecture P = Practical

( )*Practical hour already distributed in the semester concerned

Table 8. Distribution of Contact Hours and Credits
(Core, Foundation & Open courses, Project /Dissertation)

Course Code	Course Title	Semester I			Semester II			Semester III			Semester IV			Semester V			Semester VI			Total	
		Contact Hours		Credits	Contact Hours		Credits	Contact Hours		Credits	Contact Hours		Credits	Contact Hours		Credits	Contact Hours		Credits	Contact Hours	Credits
		T	P	C	T	P	C	T	P	C	T	P	C	T	P	C	T	P	C		
MB1141	Methodology & Perspectives of Science	3		3																3	3
MB1221	General Informatics & Bioinformatics				3	1	3													4	3
MB1341	Fundamentals of Microbiology							3												3	3
MB1441	Microbial Genetics & Immunology										3									3	3
MB1442	Practical (MB1141, MB1341 & MB1441)		1						2			2	4							5	4
MB1541	Instrumentation in Microbiology													4		4				4	4
MB1542	Environmental Microbiology													4		3				4	3
MB1543	Medical Microbiology & Molecular Biology													5		3				5	4
MB1544	Practical II (MB1541 &MB1542)														5	4				5	4
MB1551.1 MB1551.2 MB1551.3	Mushroom Culture Microbial Waste Management Biofertilizer Technology													3		2				3	2
MB1641	Industrial Microbiology																4		4	4	4
MB1642	Bioinformatics & Biostatistics																4		4	4	4
MB1643	Food & Dairy Microbiology																4		4	4	4
MB1644	Practical III (MB1543 & MB 1641)																	5	4	5	4
MB1645	Practical IV (MB 1642 & MB 1643)																	4	3	4	3
MB1661	Biosafety in Microbiology																3		2	3	2
MB1646	Project, Tour Diary, Viva Voce														2				3	5	4

Duration of Examination (Theory & Practical): 3 Hours
Continuous Evaluation (CE): 25%; End Semester Evaluation (ESE): 75%
Total Weightage for Each Course (Theory & Practical): 30
Total credits for the entire programme: 120

Table 9. Scheme of Evaluation of Foundation Course II, Core Courses, Open Courses & Project

Semester	Course Code	Course Title	Weightage		Duration of Univ. Exam
			CE	ESE	
I	MB 1141	Methodology and Perspectives of Science	4	30	3 Hours
II	MB 1221	General Informatics & Bioinformatics	4	30	3 Hours
III	MB 1341	Fundamentals of Microbiology	4	30	3 Hours
IV	MB 1441	Microbial Genetics & Immunology	4	30	3 Hours
V	MB 1541	Instrumentation in Microbiology	4	30	3 Hours
	MB 1542	Environmental Microbiology	4	30	3 Hours
	MB 1543	Medical Microbiology & Molecular Biology	4	30	3 Hours
	MB 1544	Instrumentation in Microbiology & Environmental Microbiology (Practical)	4	30	3 Hours
	MB 1545	Medical Microbiology & Molecular Biology (Practical)	4	30	3 Hours
	MB 1551.1 MB 1551.2 MB 1551.3	Mushroom Culture Microbial Waste Management Bio-fertilizer Technology	4	30	3 Hours
VI	MB 1641	Industrial Microbiology	4	30	3 Hours
	MB 1642	Bioinformatics & Biostatistics	4	30	3 Hours
	MB 1643	Food & Dairy Microbiology	4	30	3 Hours
	MB 1644	Industrial Microbiology & Food & Dairy Microbiology (Practical)	4	30	3 Hours
	MB 1645	Bioinformatics & Biostatistics (Practical)	4	30	3 Hours
	MB 1661.1	Bio-safety in Microbiology	4	30	3 Hours
	MB 1646	Project, Tour Diary Viva Voce		20	3 Hours

CE= Continuous Evaluation ESE= End Semester Evaluation

PATTERN OF THEORY QUESTION PAPER

Salient features:

• Question paper is set up based on grading system/marks
• The duration of exam for each course is fixed to 3 hours
• The question paper consists of five sections A, B, C & D Section A consists of 16 questions and a bunch of 4 questions carries 1 weightage
• Section B contains 12 very short answer questions of which the candidate can choose 8 and carries 1 weightage each
• Section C has 8 short answer type questions of which the candidate has to answer 5 with a weightage of 1 each
• The last section D consists of 3 questions and the candidate gets the freedom to answer 2 questions with a weightage of 4 each
• Total weightage is 30/paper

EVALUATION AND GRADING

The Evaluation of each course shall consist of two parts 1) Continuous Evaluation (CE) 2) End Semester Evaluation (ESE). The CE and ESE ratio shall be 1:4 for both courses with or without practical. There shall be a maximum of 80 marks for ESE and maximum of 20 marks for CE. For all courses (Theory and Practical), Grades are given on a 7-point scale based on the total percentage of mark (CE+ESE) as given below:

Criteria for Grading

Percentage of marks	CCPA	Letter Grade
90 and above	9 and above	A+ Outstanding
80 to < 90	8 to<9	A Excellent
70 to <80	7to<8	B Very Good
60 to < 70	6to<7	C Good
50 to < 60	5to<6	D Satisfactory
40 to < 50	4to<5	E Adequate
Below 40	<4	F Failure

Theory

Component	Weightage
Attendance	1
Assignment/ Seminar	1
Test paper	2
Total	**4**

Practical

Component	Weightage
Attendance	1
Viva-voce	1
Test	2
Total	**4**

End Semester Assessment (ESA)

Details of Papers	Duration of Exam	Weightage		
Theory & Practicals		External	Internal	Total
Microbiology (Core) Courses	3 Hours	30	4	34
Complementary Courses	3 Hours	30	4	34
Open Courses	3 Hours	30	4	34

Consolidation of Grades for CE for Theory course
Example:

Component	Weightage (W)	Grade awarded	Grade points (G)	Weighted Grade points(W×G)
Attendance	**1**	**B**	**3**	**3**
Assignment/Seminar	**1**	**C**	**2**	**2**

Test paper	**2**	**A**	**4**	**8**
Total	**4**			**13**
CE Grade	Total weighted grade points/Total weights=13/4=3.25=**Grade B**			

• With regard to the **attendance** (weight=1), the following grading scheme shall be followed:
Below 75% -**E**; 75-79%- **D**; 80-89% - **C**; 90-94%- **B**; 95-100%- **A**.
• For **assignment/ Seminar** (weight -1), the teacher shall define the quality in terms of **structure, content, presentation** and **punctuality** in submission.
• **Test papers** (weight=2) shall be graded by the same procedure adopted for theory exam evaluation

The students are required to write a minimum of 2 class tests in every semester for each course. Grades for the test component in CE shall be awarded on the basis of calculating average of the grades secured for the two class tests. Each student shall be required to do one assignment or one seminar for each Course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher/teachers in charge of CE and the same shall be assessed by a group of teachers including the teacher/teachers in charge of that Course.

CONSOLIDATION OF THE GRADE OF A COURSE
The grade of a course is consolidated by combining the ESE and CE grades taking care of their weights
Example:

Exam awarded	**Weight points(G)**	**Grade Points (WxG)**	**Grade**	**Weighted grade**
ESE	3	2.47	C	7.41
CE	1	3.20	B	3.20
Total	4			10.61
Grade of Course	Total weighted grade points/Total weights=10.61/4=2.65=Grade B			

END SEMESTER ASSESSMENT (ESA)
The University shall conduct the external examinations for all semesters. There will not be any supplementary exams. The practical examinations for **Core courses** shall be conducted at the end of 4^{th}, 5^{th} and 6^{th} semesters and **Complementary** courses at the end of 4^{th} semester according to the common calendar and questions set up by the University. The Board of Examiners constituted by the University will have the right to make necessary changes in the pattern of practical examination as and when needed.

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION
Submisiion of the following
• Certified and *bona fide* practical record
• Certified field work
• Certified tour report

• Project report/Dissertation (certified and *bona fide*)

PROJECT

Project work/Dissertation is compulsory. It can be carried out either individually or by a group not exceeding 15 students. The topics shall either be allotted by the supervising teacher or be selected by the student in consultation with the supervising teacher. The project report/dissertation duly attested by the Supervising teacher and Certified by the Head of the Department, has to be submitted on the day of examination of **Practical - II (Core)**. The project shall be evaluated by an external examiner. The project report/ Dissertation (not less than 40 pages) shall be prepared as per the format given below.

1. Title page /Front page (Certified by the **HOD**)
2. Declaration by the candidate
3. Certificate attested by the Supervising teacher
4. Acknowledgement, if any
5. Table of contents
6. Abbreviation, if any
7. Abstract/ Summary
8. Introduction & Review of Literature (10pages)
9. Material and Methods
10. Results and Discussion (Not less than 10 pages)
11. Conclusion
12. References

Tables, Graphs, Photographs etc. can be used to present the data. Topics selected once should not be repeated.

STUDY TOUR

• Visit to a Microbiology Laboratory/Distillary /Biofertilizer unit etc within or outside Kerala with a minimum duration of 3 days is compulsory

• A brief report of the trip has to be submitted, along with appropriate photographs

CORE COURSES

Semester	Course Code	Title of the Course	Cotact hrs/week L	P	Credits
I &II	MB1141	Methodology and Perspectives of Science	3	1	3
III	MB1341	Fundamentals of Microbiology	3	2	3
IV	MB1441	Microbial Genetics & Immunology	3	2	3
V	MB1541	Instrumentation in Microbiology	4	3	4
	MB1542	Environmental Microbiology	4	2	3
	MB1543	Medical Microbiology & Molecular Biology	5	2	3
	MB1544	Practical I (MB1141, MB1341 & MB1441	-	(5)	4
	MB1545	Practical II (MB1541 & MB1542)	-	(5)	4
VI	MB1641	Industrial Microbiology	4	3	4
	MB1642	Bioinformatics & Biostatistics	4	2	4
	MB1643	Food & Dairy Microbiology	4	2	4
	MB1644	Practical III (MB1543 & MB1641	-	(5)	4
	MB1645	Practical IV (MB1642 &MB1643)	-	(4)	3

METHODOLOGY AND PERSPECTIVES OF SCIENCES

Course code: MB1141
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 18hrs (Practical)
Aim of the course: To introduce the methodology and perspectives of Science in general so as to enable the students to systematically pursue his particular discipline in science in relation to other disciplines that come under the rubric of sciences.
Objectives:
- To familiarize the students with the fundamental characteristics of science as a human enterprise
- To see how science works
- To apply scientific methods independently
- To interpret scientific data using basic statistical methods

MODULE-I
Science and Science Studies **10 hrs**
1. Types of knowledge: practical, theoretical and scientific knowledge
2. Information: What is science; what is not science; laws of science; basis of scientific laws and factual truths.
3. Science as a human activity; scientific temper and empiricism, vocabulary of science, science disciplines
4. Revolution in Science and Technology

MODULE- II
Methods and Tools of Science **16 hrs**
1. Hypotheses; theories and laws in science; Observations, evidences and proofs;
2. Posing a question; formulation of hypothesis; Hypothetico-deductive model; inductive model. Significance of verification (proving) corroboration and falsification (disproving), auxiliary hypothesis; adhoc hypothesis
3. Revision of scientific theories and laws.
4. Importance of models, simulations and virtual testing

MODULE-III
Experimentation in Science **10 hrs**
1. Design of an experiment: experimentation; observation; data collection; interpretation and deduction.
2. Necessity of units and dimensions: repeatability and replication; documentation of experiments; record keeping, connection between measurements and underlying theory.
3. Types of Experiments-Experiments to test a hypothesis-to measure a variable or to gather data by preliminary and explorative experiments
16
4. Planning of experiments- Design-selection of controls-observational requirements,-

instrumental requirements.

MODULE- IV

Data handling and Ethics in Science 18 hrs

1. Documentation of experiments: Nature and types of data-typical examples; Data acquisition; treatment of data; data interpretation Significance of statistical tools in data interpretation; errors and inaccuracies.
2. Data presentation: graphs, tables, histograms and pie diagrams.
3. Statistical testing of hypothesis, null hypothesis, Significance test. Statistics based acceptance or rejection of a hypothesis; Deduction of scientific correlation; patters and trends.
4. Ethics in Science: Scientific information; depositories of scientific information, primary secondary and digital sources; sharing of knowledge; transparency and honesty; danger of pre conceived ideas.

Practical 18 hrs

1. Workout problems on frequency distribution, measures of central tendencies, measures of dispersion.
2. Prepare charts on great biological inventions
3. Familiarizing with different biological instruments.

REFERENCES

1. Gieryn T.F. (1999) *Cultural Boundaries of Science* Univer. Chicago Press.
2. Jeffrey A. Lee (2010) The Scientific Endevor. Pearson Delhi
3. Collins H.and T Punch (1993). *The Golem. What everyone should know about Science*. Cambridge Univ. Press
4. Hewitt, Paul G, Suzanne Lyons, John A, Suchocki and Jennifer Yeh (2007) *Conceptual Integrated Science*, Addison-Wesley
5. Newton RG: *The truth of Science*, 2nd edition
6. Bass, Joel, E *et al* (2009) Methods for teaching Science as Inquiry, Allyn& Bacon.

FUNDAMENTALS OF MICROBIOLOGY

Course code: MB1341
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 36hrs (Practical)

MODULE I 12 hrs

Definition, scope and history of microbiology. Difference between the prokaryotic and eukaryotic microorganisms. Classification of microorganisms – general principles and nomenclature –Whittaker's five kingdom concept. Carl Woese's three domain system of Classification-Classification and characterization of bacteria according to Bergey's Manual of Systematic Bacteriology (9th edition). Basic understanding of classification of viruses, algae, fungi and protozoa.

MODULE-II 12 hrs

Principles and applications of microscopy simple, compound, bright field, dark field, phase contrast, fluorescent and electron microbiology. Principles of staining: Nature of dyes, types of staining – simple, differential, negative and spore staining, Sterilization: Principles and methods of physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorites) sterilization. Antimicrobial chemotherapy.

MODULE- III 6 hrs

Physiology of microbial growth and nutrition. Batch, continuous and synchronous cultures; Growth Curve. Nutritional requirements. Transport of nutrients by active and passive transport. Sporulation.

MODULE- IV 14 hrs

Energy production in bacteria- Energy and ATP, aerobic respiration, Glycolysis and tricarboxylic acid cycle, Electron transport and oxidative phosphorylation in Bacteria, catabolism of other carbohydrates. Anaerobic respiration- Fermentation, alcohol fermentation by yeasts and bacteria, lactic acid fermentation, Methnogenic bacteria, Acetobacter and acetic acid fermentation.

MODULE-V 10 hrs

Methods of bacterial identification- morphological, physiological, biochemical and serological properties. Culture techniques: Types of media simple, defined, enriched and transport media with specific examples for each type. Types of streaking. Maintenance and preservation of microbes.

Practical **36 hrs**

1. Study the parts and usage of a Compound Microscope
2. Study the parts and working and uses of Autoclaves, Hot air oven, Membrane Filter, Safety Cabinet, Anaerobic Jar, Centrifuge, and Incubator.

3. Preparation of culture Media and dispensing media in test tubes, bottles, petridishes.
4. Cultivation of Bacteria on nutrient Agar for obtaining isolated colonies. Study of cultural colony characters- Size, shape, colour etc.
5. Viable Count of bacteria by pour plate/ spread plate and streak plate method.
6. Examination of wet films under high power objectives.
7. Preparation and examination of Hanging drop mount for studying the motility of bacteria.
8. Preparation of slide smears for staining.
9. Staining- Principle & techniques, Simple staining, Gram Staining, Negative Staining Acid fast staining, Special Staining -endospores, volutin granules.
10. Microscopic study of Bacteria - Cocci, Bacilli
11. Preparation of Fungal media
12. Cultivation of fungi study of colony characters of yeast and mold.

REFERENCES

1. Alexopoulus C.J. and C W. Mims.(1993). Introductory Mycology (3rd edition).Wiley Eastern Ltd, New Delhi.
2. Heritage, J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.
3. Prescott L.M. Harley J.P. and Klein D.A. (2003). Microbiology (5th edition) McGraw Hill, New York.
4. Madigan, M.T. Martinko.J.M and Parker J Brock T.D. (1997). Biology of Microorganisms. (8th edition).Prentice Hall International Inc, London.
5. Nester, E.W., Roberts, C.V. and Nester, M.T. (1995).Microbiology, A human perspective. IWOA, U.S.A.
6. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
7. Salle, A.J. (1996). Fundamental principles of Bacteriology. (7th edition).Tata McGraw - Hill publishing company Ltd, New Delhi.
8. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, U.S.A.
9. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology. (5th edition). McGraw - Hill company, New York.
10. Schelegel, H.G. (1993) General Microbiology, 7th Edn.Cambridge University Press, Cambridge.

MICROBIAL GENETICS & IMMUNOLOGY

Course code: MB1441
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 36hrs (Practical) Total: 90 hrs

MODULE I 15 hrs

History and scope of immunology; Infection and immunity, Innate and adaptive immunity-humoral and humoral and cell mediated immunity, Cells and organs involved in immune system clonal selection theory, Lymphocyte activation Antigens-types, properties Haptens Adjuvants, Vaccines-Types-Toxoids - antitoxins –DNA vaccines and subunit vaccines response-T-cell, B-cell. clonal selection theory. Lymphocyte activation. Clonal proliferation, Differentiation., CD markers. Complement. Antigens – properties, types. Vaccine. Immunoglobulins – types, structure and functions of different classes of IgG – theories of Antibody formation; Mechanism of immune response.

MODULE II 15 hrs

Imunoglobulins-Structure types and properties. Monoclonal antibody Complement structure properties, function of complement components and pathways, Major histocompatibility complex-HLA, H2-Antigen Antibody reaction-Precipitation reactions, agglutination reactions Immunofluorescence, ELISA, RIA

MODULE III 4 hrs

Immunohaematology, Blood groups, Blood transfusion Rb incompatibilities, Hypersensitivity reactions Type I, II, III & IV, Brief account of Transplantation immunology, Autoimunity, Tumor immunology Vaccines: Principles underlying the preparation of live and attenuated vaccines. Synthesis of peptide vaccines.

MODULE IV 10 hrs

Microbial genome-basic structure, Molecular concept of gene. Bacterial plasmids – structures & properties; Bacteriophage – Lytic & Lysogenic cycle – phage λ. Structures of bacterial Transposons – Types of bacterial transposons.

MODULE V 10 hrs

Gene transfer – transformation, Conjugation (Fertility factors, F+ and F- cells, F pili, high frequency recombination) and transduction. Operon concept: Lac operon – trp operon. Mutations: types and mechanisms – Ames test, Role of mutation in evolution. Mechanism of Antibiotic resistance.

Practical 36 hrs

1. Slide agglutination test ,Blood grouping, ASO

2. Bacterial agglutination test
3. Precipitation reaction - RPR ,VDRL, ODD, RID
4. ELISA-Demonstration
5. Titration of Antibody - Widal Test.

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1. Ivan M. Roit. (1994) Essential Immunology – Blackwell Scientific Publications, Oxford.
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3. Kuby, J. (1994) Immunology, 2nd Edn. H.W.Freeman and Company, New York.
4. Hue Davis (1997). Introductory Immunology (First Edition). Chapman & Hall Publisher, London.
5. Paul (1998). Fundamental Immunology, II Edition, Raver Press, New York.
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9. Roitt, I.M. (1988) Essential Immunology. Blackwell Scientific Publications, Oxford.
10. Jacqucline S, Williams and Wilkins A. (1998) Basic Immunology - Warerly Company.
11. Janeway Travers. (1997). Immuno biology - The immuno system in health and Disease. 3rd edition Current Biology Ltd., London, New York.
12. Lydyard P, Whelan A and Fanzer MW (2000) Instant notes in Immunology, Edited By Hames BD, Viva Books Private Ltd.
13. Mark Reakman Diego Vergani. Basic and clinical immunology, Longman Asia Ltd., Hong kong.
14. Richard M. Hyde. (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing Company.
15. Holt J.S, Kreig N.R, Sheath P.H.A, Williams S.T. (1994) Bergey's Manual of Determinative Bacteriology (9th ed.), Williams & Wilkins, Baltimore.

INSTRUMENTATION IN MICROBIOLOGY

Course code: MB1541
Number of credits: 4
Number of contact hours: 72 hrs (Lecture); 36hrs (Practical) Total: 108 hrs

MODULE- I
Basic laboratory Instruments **8 hrs**
Common laboratory equipment –Incubators – Biosafety Cabinent - Principle and working of pH meter, Laminar-air flow. Centrifugation: Types & principles and their applications- Lyophilizer - Flow cytometry.
MODULE- II **4 hrs**
Chromatographic techniques
Theory, principles and applications of paper, thin layer, gel filtration, ion exchange,
MODULE-III **6 hrs**
Electrophoretic techniques
Basic principles of electrophoresis, theory and application of paper and agarose electrophoresis.
MODULE-IV
Spectroscopy **8 hrs**
Spectroscopic techniques, theory and applications of UV, Visible, IR, NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.
MODULE-V
Radioisotopic techniques **10 hrs**
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.

Practical **36 hrs**
1. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
2. Separation of serum protein by horizontal submerged gel electrophoresis.
3. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
4. Quantitative estimation of hydrocarbons/pesticides/organic Solvents /methane by Gas chromatography.
5. Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry

REFERENCES
1. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S.Himalaya Publishing House, Mumbai.

2. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
3. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
4. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons.Inc., New York.
5. Analytical Biochemistry by Holme.
6. Introduction to High Performance Liquid Chromatography by R R. J. Hamilton and P. A. Sewell.

ENVIRONMENTAL MICROBIOLOGY

Course code: MB1542
Number of credits: 3
Number of contact hours: 72 hrs (Lecture); 54 hrs (Practical) Total: 126 hrs

MODULE I 18 hrs

Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microoganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem-as producers and decomposers.

MODULE II 14 hrs

Microbes in aquatic environments: The nature of aquatic habitats, Methods used in the study of aquatic (fresh and marine water) microbial community, Pollution of aquatic habitats, Water quality criteria, Water-borne diseases, Microbiological analysis of water purity, Indicator organisms, ground water quality and home treatment system.

MODULE III 10 hrs

Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Droplet and droplet nuclei; Assessment of air quality; Air sanitation; Air-borne diseases.

MODULE IV 15 hrs

Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals such as As, Sb, Hg, Pb and Cd, Microbial life in conditions of high irradiation, Radiosensitivity; mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations, Microbes in space.

MODULE V 15 hrs

Environmental application: Waste –types; Treatment of solid wastes –composting, Vermiform composting, silage, Pyrolysis and scarification; Treatment of liquid wastes, degradation of liquid industrial wastes; Degradation of pesticides and detergents;
Degradation of lignin; synthetic polymers; Xenobiotic compounds; Alkyl benzyl sulphonates; Petroleum and hydrocarbon degradation.

Practical 54 hrs

1. Determination of BOD and COD of wastewater. Water analysis a) MPN method b) Memberane filter method.
2. Quantification of microorganisms in air by settle plate and air sampler methods.
3. Detection of aflatoxin B1 from moldy grains using thin layer chromatography.
4. Isolation and identification of *E. coli* from water samples and its identifications.
5. Environmental distribution of microorganisms -Examination of microbial flora of the available soil and water samples

REFERENCES

1. Atlas Ronald, M., Bartha, and Richard (1987). Microbial Ecology 2nd Edition. Benjamin/Cummings Publishing Company, California.
2. Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.

3. Ec Eldowney S, Hardman D.J., Waite D.J., Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
4. Grant W.D. and Long, P.L. (1981). Environmental Microbiology. Blackie Glasgow and London.
5. Mitchel, R. (1992). Environmental Microbiology. Wiley – John Wiley and Sons. Inc. Publications, New York.
6. Clescri, L.S., Greenberg, A.E. and Eaton, A.D. (1998). Standard Methods for Examination of Water and Waste

MEDICAL MICROBIOLOGY

Course code: MB1543
Number of credits: 4
Number of contact hours: 90 hrs (Lecture); 36 hrs (Practical) Total: 126 hrs

MODULE I 7 hrs

Classification and general properties of medically important bacteria. Recommendation for collection, transport of specimens, isolation of bacteria from clinical specimens. Primary media for isolation and their quality control – Antibiotic sensitivity discs, testing procedures and their quality control.

MODULE II 12 hrs

Staphylococcus, *Streptococci* and related Catalase negative Gram positive cocci; *Neisseria* and *Branhamella Corynebacterium* and related organisms. *Mycobacterium* - typical and atypical. Aerobic pathogenic actinomycetes.. *Bacillus*, *B. anthracis*, *Vibrios*, *Aeromonas*, *Helicobacter*, *Pseudomonas*, *Brucella*, *Haemophilus*, *Bordettella*. *Enterobacteriaceae*, *Salmonella*, *Shigella*, *Proteus*, *Escherichia*, *Klebsiella. Clostridia, Mycoplasma, Rickettsiae, Spirochetes, Trepenema, Leptiospira* and *Borrelia*.

MODULE III 12 hrs

Morphology, Taxonomy, Classification of fungi. Characteristics of Zygomycetes, Ascomycetes, Basidiomycetes and Duteromycetes. Dermatophytes and agents of superficial mycoses. Trichophyton, Epidermophyton and Microsporum. Opportunistic mycoses- Candidiasis, Cryptococcosis, Aspergillosis. Systemic mycoses- Histoplasmosis, Coccidioidomycosis, Blastomycosis. Subcutaneous mycoses- Sporotrichosis, Mycetoma.. Collection, transport of specimens, isolation of fungi from clinical specimens. Newer methods in diagnostic mycology. Mycotoxins, Antifungal agents, testing methods and quality.

MODULE IV 7 hrs

Introduction to medical Parasitology – Classification, Protozoa – Entameoba – Plasmodium, Leishmania – Trypanosoma –Giardia – Trichomonas – Balantidium. Platyhelminthes – Taenia – Fasciola – Paragonimus – Schistosoma. Nematihelminthes – Ascaris – Ankylostoma – Enterobius – Trichuris – Trichinella – Wuchereria – Dracanculus. Laboratory techniques in parasitology.

MODULE V 8 hrs

General Properties of viruses – Detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Cultivation of Viruses. Arthropod borne and rodent borne virus diseases – Picorna viruses and diseases. Hepatitis viruses: Rabies and other neuro viruses: Orthomyxo and Paramyxoviruses.

MODULE VI 8 hrs

Pox, Adeno, Herpes, Reo, Rota and HIV Viruses, Oncogenic viruses, Viral vaccines, their Preparation and their immunization schedules. Viruses of importance to bacteria – Bacteriophages – Their Structure, types – Uses in Microbiology. Applied virology – Viral diseases, epidemiology diagnosis, prevention and treatment. Vaccines and interferons – Antiviral agents.

Practical 36 hrs

1. General requirements of collections, transport of clinical Specimens – Methods of enriched, selective and enrichment culture techniques used to isolate organisms from clinical materials. Simple, differential and special staining of clinical materials viz: throat swab, pus, urine, sputum, stool etc. Enumeration of bacteria in urine, quantitative urine culture.
2. Isolation and identification of bacterial pathogens from clinical specimens their biological reactions. Antimicrobial Sensitivity testing by disc-diffusion technique and determination of MIC.
3. Identification of pathogenic viruses in Slides/ Smears / Spotters. Isolation of phage from natural sources.
4. KOH and Lactophenol preparations for skin scrapings for dermatophytes. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.
5. Direct examination of faeces- wet mount and Lugol's iodine method demonstration of protozoan cysts and helminthes eggs. Concentration techniques of stool specimen- floatation and sedimentation methods. Examination of blood for malarial parasites, thin & thick smears preparation. Identification of pathogenic parasites in slides/ specimens as spotters.

REFERENCES

1. Alexopoulus CJ and C W. Mims. (1993).Introductory Mycology (3rd edition) WileyEastern Ltd, New Delhi.
2. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai.
3. Balows, A., Hauser Jr K.L., Isenberg, H.D., Shalomy, H.J. (1991). Manual of Clinical Microbiology, ASM, Washington D.C.
4. Bridge, E.A. (1994) Bacterial and Bacteriophage Genetics, 3rd Edn. Springer–Verlag,New York.
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6. Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey.
7. David Greenwood, Richard CD., Slack, John Forrest Peutherer. (1992). Medical Microbiology. 16th edition. ELBS with Churchill Livingstone.
8. Dubey RC and Maheswari DK (2005). A text book of Microbiology, Revised Multicolour edition, S.Chand Publishers, New Delhi.
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10. Fenner, F. and White, D.O. (1970) Animal Virology. Academic Press,New York.
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12. Hayes, W. (1968) The Genetics of Bacteria and their Viruses. Blackwell Scientific Publications, London.
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16. Lorian, V. (1991) Antibiotics in laboratory medicine, 3rd edition, Williams and Wilkins, Baltimore.
17. Luria, S.E., Darnel, J.E., Jr., Baltimore, D. and Campbell, A. (1978) General Virology, 3rd Edn. John Wiley & Sons, New York.
18. Pelczar & Kreig (2006). Microbiology5th edition. Tata McGraw Hill, New Delhi
19. Purohit SS (2005). Microbiology - Fundamentals and Applications. Student Edition Publishers, Jodhpur.

20. Ronald M. Atlas, Lawrence C. Pazis (1993) Hand book of Microbiological Media. Ed. LC. CRC Press, London.
21. Schmidt, G.D. and Roberts, L.S. (1981) Foundations of Parasitology, 2nd Edn, Mosby, St. Louis.
22.Timbury, M.C. (1986) Medical Virology, 9th Edn. Churchill Livingstone, London.
23. Topley & Wilsons's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III Bacterial Diseases, Edward Arnold, London.

INDUSTRIAL MICROBIOLOGY

Course code: MB1641
Number of credits: 4
Number of contact hours: 72 hrs (Lecture); 54 hrs (Practical) Total: 126 hrs

MODULE-I **15 hrs**

Introduction to fermentation process. Microbial growth kinetics-batch, continuous and fed batch culture. Large scale cultivation of industrially important microbes. Fermentation media design, desired qualities of fermentation media and formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

MODULE-II **15 hrs**

Types of fermentation process-(submerged and solid state) different types of fermentors, basic functions, design and components. Specifications of fomenters- sterilization of fomenters- aseptic inoculation methods. Brief idea on monitoring and control of variables such as temperature, aeration, agitation, pressure, pH, foaming.

MODULE-III **7 hrs**

Microbial products of commercial use: penicillin, xanthan gum**,** ethanol, vitamin B 12, protease, citric acid, glutamic acid and L- lysine. SCP and microbial enzymes.

MODULE-IV **15 hrs**

Scale up and down stream processing of biologicals. Separation of cells, cell disruption and recovery. Direct extraction of products and metabolites. Large scale separation techniques like chromatographic and affinity techniques, membrane filtration –ultra filtration and reverse osmosis. Spray drying, drum drying & freeze drying.

MODULE-V **20 hrs**

Ecology of microorganisms affecting pharmaceutical industries atmosphere- water- raw materials- packaging- equipment. Factors affecting microbial spoilage of pharmaceutical products - Control of contamination during manufacture- good pharmaceutical manufacturing process. Quality control of pharmaceutical products. Manufacture of sterile pharmaceutical products- injections and ophthalmic preparations.

Practical **54 hrs**

1. Enumeration and isolation of Lactobacillus from curd
2. Enumeration and isolation of Bacteria and mold from fermented foods
3. Production of Alcohol from Cashew Apple
4. Mushroom cultivation
5. Wine Production from grapes
6. Immobilization of yeast cells

REFERENCES

1. Casida, J.E. (1968) Industrial Microbiology. Wiley Eastern, New Delhi.
2. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
3. Hugo WB and Russell AD. (1989) Pharmaceutical Microbiology IV edition. Blackwell Scientific Publication, Oxford.
4. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1995) Principles of Fermentation Technology, 2nd Edn. Pergamon Press, Oxford.
5. Peppler, H.J. and Pearl Man, D. (1979) Fermentation Technology, Vol 1 & 2, Academic Press, London.

BIOINFORMATICS AND BIOSTATISTICS

Course code: MB1642
Number of credits: 4
Number of contact hours: 72 hrs (Lecture); 36 hrs (Practical) Total: 108 hrs

MODULE I **8 hrs**

Overview of information Technology: Features of the modern personal Computer and peripherals, computer network and internet, introduction to mobile phone technology, purchase of technology, license, guarantee, overview of operating system and major application softwares.

MODULE II **15 hrs**

Bioinformatics**:** Introduction: Definition, Origin of concept of Bioinformatics; Brief history, Importance of bioinformatics; Web lab and Wet lab. Biological databases: Brief account on Model/organism databases, Biodiversity databases and Biomolecular databases - Nucleic acid databases Eg: EMBL, Gen Bank - Protein sequence databases. Eg: PIR, SWISS PROT. Bioinformatics in relation to Biomolecular structure • Protein structure databank- PDB - Molecular visualization- use of Rasmol- Molecular modeling (Brief account only). Molecular docking and computer aided drug design (Brief account only)

MODULE III **14 hrs**

Basics of Genomics and Proteomics, Comparative genomics and Pharmacogenomics 2. Sequence analysis and alignment (brief account only). Pair wise sequence alignment. Multiple sequence alignment: Molecular Phylogeny and Phylogenetic trees. Advantages of Molecular phylogeny and phylogenetic analysis. Bioinformation Tools: BLAST, CLUSTAL X

MODULE IV **10 hrs**

Science and Tools of Science:Types of knowledge: practical, theoretical and scientific knowledge. Basis for Scientific laws and factual truths.Revolutions in Science and Technology.Hypothesis; theories and laws in Science; observations, evidences and proofs.Significance of peer Review.

MODULE V **15 hrs**

Experimentation in Science and Data Handling.Design of an experiment; experimentation; observation; data collection; interpretation and deduction.Necessity of units and dimensions; repeatability and replication.Documentation of experiments, Record keeping.Connection between measurements and underlying theory.Documentation of experiments.Nature and types of data -typical examples; data acquisition; treatment of data; data interpretation. Significance of

statistical tools in data interpretation: graphs, tables, histograms and pi diagrams.Statistical testing of hypothesis, null hypothesis. Significance test -Statistics based acceptance or rejection of a hypothesis. Deduction of scientific correlation, patterns and trends.

MODULE VI **10 hrs**

Nature and scope of statistical methods and their limitation.compilation, classification, tabulation, and application in life science.Graphical representation, Measure of average and dispersion mean, medium, mode. Sampling methods -simple random, stratified, systematic and cluster sampling procedures. Sampling distribution, Probability, Tests of significance based on T, Chi-square and F Test Designing and methodology of experiment.

Practical **36 hrs**

1. Students are expected to work with at least any one of the scientific packages, to explore the WEB and able to find, recognize, download, install and use software in various areas useful to the research in Biology.
2. Familiarization of academic data bases INFLIBNET, NICNET, and BRNET.
3. Nucleic acid databases Eg: EMBL, Gen Bank
4. Blast Search, Protein structure databank- PDB, Molecular visualization tools- Rasmol, Molecular modeling, Molecular docking and computer aided drug design.
5. Collection of data, sampling designs, tabulation and graphic representation using biological materials.
6. To find mean, mode, meridian, coefficient of variance using biological materials.
7. Tests of significance‘t’ test, ‘chi’ square, standard error and standard deviation.
8. t TEST, chi square, statistical error, standard deviation also, to be practically done through SPSS [statistical Package for Social Sciences] programme.

REFERENCES

1. Debbie Holmes, Peter Moody, Diana Dine. Research methods for the biosciences, International student edition,Oxford University Press Inc.New York
2. S.K.Aggarwal. Foundation course in Biology, Anes Student Edition, 2nd edition
3. R.C. Sobti, V.L.Sharma. Essentials ofModern Biology, Anes Student Edition.
4. Fundamentals of Biostatistics. Bernard Rosner
5. Biostatistics for medical, nursing and pharmacy students.a.indrayan and L.Satyanarayana.
6. Statistics for Biologists. Campbell.R.C
7. Fundamentals of Biostatistics. Bernard Rosner

FOOD AND DAIRY MICROBIOLOGY

Course code: MB1643
Number of credits: 4
Number of contact hours: 72 hrs (Lecture); 36 hrs (Practical) Total: 108 hrs

MODULE I 7 hrs

Food as a substrate for microorganisms. Microorganisms important in food microbiology; Molds, yeasts and bacteria, General Characteristics.Classification and importance.

MODULE II 15 hrs

Food fermentation: wine, bread cheese, vinegar, fermented vegetables and fermented dairy products. Spoilage and defects of fermented dairy products and fermented foods.

MODULE III 10 hrs

Principles of food preservation – Asepsis – Removal of micro organisms, anerobic conditions – High temperature – Low temperature- Drying –Food additives.

MODULE IV 20 hrs

Food spoilage-Types of microorganisms in food and source of contamination. Factors influencing microbial growth in food. Contamination and spoilage of cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products, fish and sea foods, poultry and spoilage of canned foods.

MODULE V 20 hrs

Food borne infections and intoxications – bacterial, non-bacterial – Food borne disease outbreaks – Laboratory testing – preventing measures – Food sanitation – plant sanitation – Employees' heals standards – waste treatment and disposal –quality control.

Practical

1. Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.
2. Determination of quality of milk sample by methylene blue reductase test and Resorzurin method.
3. Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

REFERENCES

1. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.
2. Andrews AT, Varley J. (1994) Biochemistry of milk products. Royal Society of Chemistry.
3. Banwart GJ. (1989), Basic food microbiology, Chapman & Hall, New York.
4. Frazier WC and Westhoff DC. (1988) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi.
5. Hobbs BC and Roberts D. (1993) Food poisoning and food hygiene, Edward Arnold (A division of Hodder and Stoughton), London.
6. Jay JM. (1987) Modern food microbiology, CBS Publishers and distributors, New Delhi.
7. Robinson RK. (1990) The microbiology of milk. Elsevier Applied Science, London.

8. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1995) Principles of Fermentation Technology, 2nd Edn. Pergamon Press, Oxford.
9. Casida, J.E. (1968) Industrial Microbiology. Wiley Eastern, New Delhi.

FOUNDATION COURSE

FOUNDATION COURSE-II

Semester	Course Code	Title of the Course	Contact hrs/week		Credits
			L	P	
II	MB1221	General Informatics and Bioinformatics	3	1	3

MB 1221: GENERAL INFORMATICS AND BIOINFORMATICS

Course code : MB1221
Number of credits : 3
Number of contact hours : 54 hrs (Lecture); 18 hrs (Practical)

MODULE- I **6 hrs**

Overview of information Technology: Features of the modern personal Computer and peripherals, computer network and internet, introduction to mobile phone technology, purchase of technology, license, guarantee, overview of operating system and major application softwares.

MODULE- II **8 hrs**

Knowledge skill for Higher Education: Data information and knowledge, knowledge management- Internet as a knowledge repository, academic search techniques, creating your cyber presence, open access initiatives, open access publishing models, basic concepts of IPR, copy rights and patents, plagiarism, introduction to use of I T in teaching and learning, case study of educational software, Academic services-INFLIBNET, NICNET and BRNET.

MODULE- III **10 hrs**

Social Informatics: IT and Society- issues and concerns- digital divide, IT and development, new opportunities and new threats, Cyber ethics, Cyber crime, Security, privacy issues, cyber addictions, Information overload, Health issues, guidelines for proper usage of computers, internet and mobile phones. Localization issues-IT and Regional languages-IT for the disabled, the free software debate.

MODULE-IV **15 hrs**

Bioinformatics

1. Introduction: Definition, Origin of concept of Bioinformatics; Brief history, importance of bioinformatics; Web lab and Wetlab.
2. Biological databases: Brief account on Model/organism databases, Biodiversity databases and Biomolecular databases
- Nucleic acid databases Eg: EMBL, Gen Bank
- Protein sequence databases. Eg: PIR, SWISS PROT
3. Bioinformatics in relation to Biomolecular structure
• Protein structure databank- PDB
• Molecular visualization- use of Ras mol
• Molecular modeling (Brief account only)
• Molecular docking and computer aided drug design (Brief account only)

MODULE-V **15 hrs**

1. Basics of Genomics and Proteomics, Comparative genomics and Pharmacogenomics
2. Sequence analysis and alignment (brief account only)
• Pair wise sequence alignment

• Multiple sequence alignment
3. Molecular Phylogeny and Phylogenetic trees
Advantages of Molecular phylogeny and phylogenetic analysis
4. Bioinformation Tools: BLAST, CLUSTAL X

Practical **18 hrs**

1. Create, Copy and Save a document with Header, Footer, Page Number, Date and Time using Word processing
2. Insert a table in the above Document
3. Prepare the mark list of students in a class using Excel
4. Prepare five slides each using power point with different design templates
5. Students are expected to work with at least any one of the commercial / scientific packages, to explore the WEB and able to find, recognize, download, install and use software in various areas useful to the research in Biology.
6. Blast Search
7. Molecular visualization using Rasmol

REFERENCES

1. Selzer PM, Marhofer RJ, Rohwer A (2009) Applied Bioinformatics. Springer-Verlag Berlin Heidelberg, Germany
2. Ingvar Eidhammer, Inge Jonassen,William R Tailor 2009, Protein Bioinformatics, Wiley India Edition
3. Venkatarajan S Mathura and Pandjassarame Kangueane (2009) Bioinformatics- a concept based introduction. Springer-Verlag Berlin Heidelberg, Germany
46
4. Agrawal S (2009) Bioinformatics for Beginners: Introduction to Bioinformatics. Ane Books India Pvt. Ltd
5. Niel C Jones and Pavela Pevzner (2009) An introduction to Bioinformatics Algorithms. Ane Books India Pvt. Ltd
6. Selzer (2008) Applied Bioinformatics: An Introduction, Ane Books India Pvt. Ltd
7. Kolchanov (2008) Bioinformatics of Genome regulation and Structure. Ane Books India Pvt. Ltd.
8. Rubin (2007) The Avenues in Bioinformatics. Ane Books India Pvt. Ltd.
9. Joseph Seckback and Eitan Rubin (2007) Springer, Kluwer Academic publishers
10. Jin Xiong (2007) Essential Bioinformatics. Cambridge University Press India Pvt. Ltd
11. Higgs (2005), Bioinformatics and Molecular evolution. Ane Books India Pvt. Ltd
12. Ethan Cerami (2005) XML for Bioinformatics. Springer International Edition
13. Moni K and Vijayraj N (2000) Bioinformatics a practical Approach, Coimbatore
14. Mukerjee DP (2000) Fundamentals of Computer Graphics and Multimedia. Prentice Hall of India Pvt. Ltd.

WEB RESOURCES

• www.fgcu.edu/support/office2000
• www.openoffice.org *Open office official website*
• www.microsoft.com/office *MS Office website*
• www.lgta.org *Office online lessons*

• www.learntheneth.com *Web Primer*
• www.computer.org/history/timeline
• www.computerhistory.org
• http://computer.howstuffworks.com
• http://vmoc.museophile.org *Computer history*
• www.dell.com *Dell Computers*
• www.intel.com *Intel*
• www.ibm.com *IBM*
• www.keralaitmission.org *Kerala Govt. IT Dept.*
• www.technopark.org
• http://www.studentworkzone.com/question.php?ID=139
• http://www.scribd.com/doc/259538/All-about-mobile-phones

OPEN COURSES

OPEN COURSE 1

Offered to the students from other disciplines

Semester	Course Code	Title of Course	Contact hrs/week	Credits
V	MB1551.1	Mushroom Culture	3	2
	MB1551.2	Microbial Waste Management		
	MB1551.3	Biofertilizer Technology		

OPEN COURSE-II

Offered to the students of Microbiology

Semester	Course Code	Title of the Course	Contact hrs/week	Credits
VI	MB1651	Biosafety in Microbiology	3	2

OPEN COURSE –I (a)

MUSHROOM CULTURE

Course Code : MB1551.1
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I **9 hrs**

Introduction: history & scope of edible mushroom cultivation. Types of edible mushroom available in India: *Calacybe indica*, *Volvariella Volvacea, Pleurotus* sp. and Agaricus *bisporus.*

MODULE II **10 hrs**

Pure culture technique: preparation of media & sterilization – Preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on petri plates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

MODULE III **15 hrs**

Cultivation Technology : Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood – inoculation loop – low cost stove – sieves – Culturel rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves.

MODULE IV **10 hrs**

Storage and nutrition: Short term storage – Long term storage (scanning, Pickles, papads, drying, storage in salt solutions) – Nutrition: Proteins, amino acids, mineral elements. Nutrition: Carbohydrates – Crude fiber content, vitamins.

MODULE V **10 hrs**

Economics of mushroom cultivation (fixed assets, recurring expenditure, labour, economics of cultivation throughout the year and seasonal growing formulation of project report for getting finance from funding agencies). Precautions in mushroom cultivation (precaution to be taken while selecting the area, spawn preparation, spawn run, during cropping harvesting etc.). Mushroom recipes.

Field study: Visit to a mushroom cultivating laboratory

REFERENCES

1. Marimuthu et al., (1991) Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore.
2. Nita Bahl (1988) Hand book of Mushrooms, II edition, Vol.I & II.
3. Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press.
4. Shu-Ting Chang, Philip G. Miles, Chang, S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2nd ed, CRC press.

5. Swaminathan M. (1990) Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
6. Tewari and Pankaj Kapoor S.C. (1988) Mushroom cultivation, Mittal Publications, Delhi.

OPEN COURSE-I (b)
MICROBIAL WASTE MANAGEMENT

Course Code : MB1551.1
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I **20 hrs**

General concept of sanitation and disinfection .Sanitation of industrial and food processing units Air sanitation, Safe location of animal houses, hospitals, industrial fermentation units etc based on air sanitation. Air borne diseases and preventive measures.

MODULE II **20 hrs**

Microbiology of municipal sewage and sewage treatment BOD and COD
Concept. Treatment of Industrial effluent- Waste water treatment-Mechanical and biological. Aerobic and anaerobic treatments.Domestic septic tank.Treatment of municipal water supplies water borne diseases

MODULE III **14 hrs**

Solid waste disposal-sanitary landfills, composting, vermincompost. Disposal of animal and agricultural waste.Methanogenesis and biogas production

OPEN COURSE-I (c)
BIOFERTILIZER TECHNOLOGY

Course Code : MB1551.3
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE – I **15 hrs**

General account of the microbes used as biofertilizers for crop plants and their advantages. Symbiotic N2 fixer: *Rhizobium* - Isolation, characterization, identification, Classification, inoculum production and field application. *Frankia* - Isolation, characterization – actinorrhizal nodules – non-leguminous crop symbiosis.

MODULE – II **8 hrs**

Non – Symbiotic N2 fixers – *Azospirillum* – Free living - *Azotobacter* – free isolation, characterization, mass inoculum production and field application.

MODULE – III **8 hrs**

Symbiotic N2 fixers – Cyanobacteria, Azolla – Isolation, characterization, mass multiplication – Role in rice cultivation – Crop response – field application - immobilization.

MODULE – IV **8 hrs**

Phosphate solubilizers – Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

MODULE – V **15 hrs**

Mycorrhizal bioinoculants – classification – importance of mycorrhizal association
Ectomycorzhiza – Endomycorrhiza – Ectendo mycorrhiza – Taxonomy of mycorrhizae – Isolation of VA mycorrhiza – Quantification and assessment of VAM in roots – Mass inoculum production of VAM – field applications of Ectomycorrhiza and VAM.

Field study: Visit to a biofertilizer production unit

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1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.
4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.
5. Subba Rao N.S. (1988) Biofertilizers in Agriculture and forestry Oxford and IBH Publishing

OPEN COURSE-II

BIOSAFETY IN MICROBIOLOGY

Course Code : MB1661
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I **12 hrs**

Concept of biosafety: Historical background, principles of biosafety, introduction to biological safety cabinets, selection, installation and use of biological safety cabinets, primary containment for biohazards, biosafety levels, biocontainment, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals.

MODULE II **12 hrs**

Biosafety guidelines - Government of India, definition of Genetically Modified Organisms (GMOs) and Living Modified Organisms (LMOs), Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture, Environmental release of GMOs.

MODULE III **10 hrs**

Risk Analysis, Risk Assessment, Risk management and communication. Overview of national regulations and relevant international agreements including Cartagena Protocol.

MODULE IV **10 hrs**

Plant biosafety, risk assessment, laboratory standard operating procedures, safety of laboratory personnel, environmental safety, regulated biosafety and biosecurity. Biosafety regulations and assessment of biotechnology products, drugs/vaccines and GMOs.

MODULE V **10 hrs**

Biosafety protocols, biological weapons, biosecurity, components of biosecurity program and bioethical issues. Occupational health and immunoprophylaxis, decontamination and disinfection, transportation of infectious substances and, agriculture pathogen biosafety.

REFERENCES

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2. Methods for Teaching Science as Inquiry, Bass, Joel, E and et. al., Allyn & Bacon, 2009 The truth of science, Newton R.G.,
3. Biotechnology: Issues, Ethics and Regulations, Tina M. Prow, Communications Specialist, Office of Agricultural Communications and Education.
4. Fleming, D. O. and D. L. Hunt (eds.). 2006. Biological Safety: Principles and Practices, 4th ed. ASM Press, Washington, D.C. \
5. Centers for Disease Control and Prevention and National Institutes of Health (CDC/NIH). 2007. Biosafety in Microbiological and Biomedical Laboratories, 5th ed. L. C.

Chosewood and D. E. Wilson (ed.). U.S. Government Printing Office, Washington, D.C. Available free at http://www.cdc.gov/OD/ohs/biosfty/bmbl5/bmbl5toc.htm.
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7. Sree Krishna, V. (2007) Bioethics and Biosafety in Biotechnology, New Age International (P) Ltd., Publ., Mumbai.
8. Biosafety in Microbiological and Biomedical Laboratories (2009). 5th edition. U.S. Department of Health and Human Services, Public Health Service Centers for Disease Control and Prevention, National Institutes of Health, HHS Publication No. (CDC) 21-1112.