SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

CommonMinimumSyllabusforB.Sc. Microbiology/ B.Sc. (Hons.) Microbiology/ B.Sc. Microbiology with Research

NationalEducationPolicy- 2020

Subject: Microbiology

SYLLABUS OF UG MICROBIOLOGY

(CommonMinimumSyllabusforB.Sc.Microbiology/B.Sc. (Hons.) Microbiology/B.Sc. Microbiology with Research)

(Effective from Academic Session 2022-2023-Onward)

VISION AND MISSION- DEPARTMENT OF MICROBIOLOGY

Vision

1. To be producing technical manpower through excellence in research and development, teaching, learning and training, with concern for worldwide environment and human society.
2. To provide well and quality education in the field of Life Sciences and Applied Sciences with proper training and practical expertise responsive to the needs of present and future century so that students excel and enhance in their professional life.

Mission

1. Providing friendly learning ambience to develop competence in diversified areas to create excellence in industrial, educational, research and technical areas.
2. Provide an efficient educational environment where students and research scholars can realize their full potential in their chosen disciplinary subjects and attain quality education to face the challenges of the future.
3. Establish networks collaborations and linkages with industries and academic institutes to produce ethically and morally strong workforce contributing to the development of knowledge economy.
4. Harness the skills of the students and assist them to excel in their professional life by providing life long leaning skills, sound theoretical knowledge, practical experience and all-round development with the help of well qualified and experienced faculty. Inculcate moral and ethical values for character building.

C U R R I C U L U M

B. Sc. Microbiology GRADUATE/ B. Sc.MicrobiologyHONORS/B. Sc. Microbiologywith RESEARCHDEGREE PROGRAMME

(2022-23 Onward)

1. Nomenclature:

There will be full time Biotechnology Degree Programme named as B. Sc. Biotechnology (three full academic years), B.Sc. (Hons.) Biotechnology(four full academic years) and B.Sc. Biotechnology with Research (four full academic years). The duration of this programme shall be of three years/four years (three/four full academic years) which shall be divided into six semesters/eight semesters. Each semester will be of six. months. Actual teaching in each semester is required minimum of 90 days. The examination for the first, third, fifth and seventh semester will normally be held in the month of December and for the second, fourth, sixth and eight semester in the month of May or as convenient to the University.

2. The Medium of Instruction:

The medium of Instruction will be English.

3. The Medium of Examination:

The medium of examination will be English.

4. Intake: The intake to B. Sc. (Hons.) Biotechnology course is 40 students. It may increase or decrease as per provisions of the University.

5. Eligibility to apply for Admission:

No candidate shall be eligible for admission to three years/four years Full Time B. Sc. Biotechnology (three full academic years), B.Sc. (Hons.) Biotechnology(four full academic years) and B.Sc. Biotechnology with Research (four full academic years) unless he/she has successfully completed higher secondary or Intermediate (with any biological/mathematical/science subject) with prescribed number of credits or percentage through the examinations conducted by a National/State Board. Such qualifications

as recognized by the University. Any candidate who has passed the plus two of the higher secondary board of Examinations in any state recognized as equivalent to the plus two of the Higher Secondary Board in with not less than 45 % marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules.

Duration of the Programme:3/4 Years

6. Selection Procedure for Admission: A candidate willing to seek admission to B. Sc.Microbiology(three full academic years), B.Sc. (Hons.) Microbiology((four full academic years) and B.Sc. Microbiology(with Research (four full academic years)will have to appear in written entranceTestconducted by the University or on behalf of the University and followed by the counseling as per University norms. The selection for admission will be made on merit basis or as per University norms.

7. Semesters:

(a) An academic year shall consist of two semesters :

Odd Semester (I, III, Vand VII Semester) : generally July to November/December

Even Semester (II, IV, VIand VIII Semester): generally January to May/ June

The academic calendar for each semester shall be notified well before the commencement of the semester by the Dean, School of Basic and Applied Sciences.

(b) A semester shall normally extend over a period of 15 weeks. Each week shall have 30 hours of instruction including lab/ field work as applicable.

8. Credits:

(a) Credit defines the quantum of contents/ syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus credits shall be assigned on the basis of the number of lectures/ tutorials / laboratory work/ project work and other forms of learning required to complete the course contents in a 15 week schedule.

(b) 1 Credit = 1 hour of lecture for theory and 1 Credit = 2 hour of laboratory for practicals.

(c) Motivate students with industrial visit, educational trip, seminar/conference during semester.

9. Roll Numbers and Enrollment Numbers:

The University shall allot a Roll Number to the students after payment realization, thorough scrutiny/ verification of the required documents for the course. After the completion of the admission procedure the enrolment number for the students shall be allotted by the University at the entry point which shall remain same for the entire period of study in the University.

10. The Credit Based Course Structure:B. Sc. (Hons.) Microbiology(- Three Year/Four Year Programme- Choice Based Credit System (CBCS)

B. Sc.Microbiology((three full academic years), B.Sc. (Hons.) Microbiology (four full academic years) and B.Sc. Biotechnology with Research (four full academic years) program shall be based on the choice based credit system in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week.

Total Credits:

A. 72 (MC)+48 (ME)+ 8 (OE)+12 (VC)+ 6(Minor Project/Educational Tour instead of VC in 5th and 6thsemester)+ 0 (COCCR Two lecture per semester from 1st to 6th semester without any credit)=146 (For three years B. Sc.Microbiology)

B. 146 (For three years B. Sc. Microbiology)+24 (MC)+12 (ME)+ 4 (OE)+6 (VC)= 192 (For four years B. Sc. (Hons.)Microbiology)

C. 146 (For three years B.Sc.Microbiology(. Sc.)+ 12 (MC)+ 20 (Research Project)+ 14 (Dissertation)=192 (For four years B. Sc.Microbiology(with Research)

Where,

MC= Major Core
ME= Major Elective
OE= Open Elective
VC= Vocational
MICCC= Co- Curricular Course

11.Student Advisor:

Every student shall have a teacher of the Department as his/her student advisor. All teachers of the department shall function as student advisors and will have more or less equal number of students with them. The student advisor will advise the students in choosing elective courses and offer all possible student support services.

12.Attendance:

a. The teacher handling a course shall be responsible for maintaining a record of attendance of students who have registered for the course.

b. All teachers shall intimate the Head of the Department at least seven calendar days before the last instruction day in the semester, the particulars of all students who have less than 75% attendance in one or more courses.

c. A candidate who has less than 75% attendance shall not be permitted to sit for the end-semester examination in the course in which the shortfall exists. However, it shall be open to the Dean/ HOD to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 65%.

d. A candidate who fails to put in least 75% attendance in I semester shall not be allowed to pursue the studies in next semester. Such candidates may apply to the Dean/HOD for re-registration in the II semester in the next academic session.

Note : Rest of the provisions will be as framed by the University.

13. Fee and Resource Generation

As per decision of the University.

14. Examination and Evaluation

(a) Evaluation will be done on a continuous basis. Three times during each semester. For the purpose of uniformity, there will be a uniform procedure of examination to be adopted by all teachers. There will be two sessional tests (Three if any student are unable to attend any sessional test) and one end-semester examination.

(b) Sessional tests (of one to two hours duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment. It will be obligatory for the Students to attend the both Sessional tests, failing which they will not be allowed to appear in the concerned semester examination. The sessional test as part of the continuous internal assessment shall be conducted and evaluated by the teacher offering the course. A Student cannot repeat sessional tests (without permission from HOD). However, if for any compulsive reason the student could not attend the test, the prerogative of arranging a special test lies with the teacher with the approval of the Head of the Department. In case of students who could not attend any of the sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the concerned semester examinations by the concerned faculty member after the approval of the Head of the Department and the Dean concerned.

(c) The sessional tests will carry 30% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades.

(d) There shall be a written end semester examination which shall be of 2/3 hours duration carrying 70% of total marks assigned for the course, covering the entire syllabus prescribed for the course.

(e) The end semester practical examinations (field tour report, project report and training report) shall normally be held before the theory examination/or as per convenience by the Department . The internal faculty shall associate themselves with the examination process.

NEP- 2020-Choice Based Credit System/ Bachelor of Science (Hons.) Microbiology

Certificate Course in Microbiology

First Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Major Core	MICMC-101	Introduction to Microbiology	4	0	0	4	30	70	100
2	Major Core	MICMC-102	Cell Biology	4	0	0	4	30	70	100
3	Major Elective	MICME-103a/ MICME-103b	Biochemistry/ Plant Physiology	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE 104	Introduction and Scope of Microbiology-I	2	0	0	2	30	70	100
5	Vocational	MICVO-105	Microbial Quality Control in Food and Pharmaceutical Industries	3	0	0	3	30	70	100
6	Co- Curricular Course	COCCR-106	Environmental Science	2	0	0	0	30	70	100
Practical										
1	Major Core	MICML 101	Lab course based on course MICMC 101	0	0	2	2	30	70	100
2	Major Core	MICML 102	Lab course based on course MICMC 102	0	0	2	2	30	70	100
3	Major Elective	MICMEL 103	Lab course based on course MICME 103	0	0	2	2	30	70	100
Total				21	-	6	23	320	630	950

L – Lecture, T – Tutorial, P – Practical, C – Credit

Second Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Major Core	MICMC 201	Immunology	4	0	0	4	30	70	100
2	Major Core	MICMC 202	Microbial Physiology &Metabolism	4	0	0	4	30	70	100
3	Major Elective	MICME 203a/MICME203b	Biological Technique /Basic of Foresciencic science	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE 204	Introduction and Scope of Microbiology-II	2	0	0	2	30	70	100
6	Vocational	MICVO-205	Microbial genetic	3	0	0	3	30	70	100
6	Co- Curricular Course	COCCR206	English Communication	2	0	0	0	30	70	100
Practical										
1	Core	MICML201	Lab course based on course MICMC 201	0	0	2	2	30	70	100
2	Core	MICML 202	Lab course based on course MICMC 202	0	0	2	2	30	70	100
3	Generic Elective	MICEL 203	Lab course based on course MICME 203	0	0	2	2	30	70	100
Total				19	-	6	23	270	630	900

Diploma Course in Microbiology

Third Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional	Externa	

								(Internal)	**l (ESE)**	
Theory										
1	Major Core	MICMC 301	Molecular Biology	4	0	0	4	30	70	100
2	Major Core	MICMC 302	Food Processing &Preservation	4	0	0	4	30	70	100
3	Major Elective	MICME 303a/MICME 303b	Chemistry-I/ GreenChemistry	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE 304	Vermitechnology-I	2	0	0	2	30	70	100
5	Vocational	MICVO 305	Computitional Biology &Bioinformatics	3	0	0	3	30	70	100
6	Co- Curricular Course	COCCR306	Molecular Diagnostics	2	0	0	0	30	70	100
Practical										
1	Core	MICML 301	Lab course based on course MICMC 301	0	0	2	2	30	70	100
2	Core	MICML 302	Lab course based on course MICMC 302	0	0	2	2	30	70	100
3	Major Elective	MICEL 303	Lab course based on course MICME 303	0	0	2	2	30	70	100
Total				19	-	6	23	270	630	900

L – Lecture, T – Tutorial, P – Practical, C – Credit

Fourth Semester

S. No.	**Course Category**	**Couse Code**	**Course Name**	**Periods**				**Evaluation scheme**		**Subject Total**
				L	**T**	**P**	**C**	**Sessional (Internal)**	**External (ESE)**	
Theory										
1	Major Core	MICMC 401	Industrial Microbiology	4	0	0	4	30	70	100
2	Major Core	MICMC 402	Food &Dairy Microbiology	4	0	0	4	30	70	100

3	Major Elective	MICME 403a/MICME 403b	Plant Biotechnology/Chemistry -2	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE 404	Vermi-Technology-II	2	0	0	2	30	70	50
5	Vocational	MICVO- 405	Food fermentation Technique	3			3	30	70	100
6	Co- Curricular Course	COCCR406	Drug Designing	2	0	0	0	30	70	100
Practical										
1	Core	Core	MICML 401	Lab course based on course MICMC 101		2	2	30	70	100
2	Core	Core	MICML 402	Lab course based on course MICMC 102		2	2	30	70	100
3	Core	Major Elective	MICEL 403	Lab course based on course MICME 103		2	2	30	70	100
Total				19	-	6	23	270	630	900

L – Lecture, T – Tutorial, P – Practical, C – Credit

Degree Course in Microbiology

Fifth Semester

S. No.	**Course Category**	**Couse Code**	**Course Name**	**Periods**				**Evaluation scheme**		**Subject Total**
				L	**T**	**P**	**C**	**Sessionl (Internal)**	**External (ESE)**	
Theory										
1	Major Core	MICMC 501	Agriculture Microbiology	4	0	0	4	30	70	100
2	Major Core	MICMC 502	Recombinant DNA Technology	4	0	0	4	30	70	100
3	Major Elective (Any one)	MICME 503a/MICME503 b	Beverage Biotechnology/ Animal Biotechnology	4	0	0	4	30	70	100

4	Major Elective (Any one)	MICOE 504a/MICOE504b	Bioprocess Technology/Human Immunology	4	0	0	4	30	70	100
5	Co-Curricular Course	COCCR-505	Intellectual Property Rights	2	0	0	0	30	70	50
6	Project 1	MICPE506	Project/Educational Tour Report I	0	0	0	3	100	-	100
Practical										
1	Core	MICML 501	Lab course based on course MICMC 501	0	0	2	2	30	70	100
2	Core	MICML 502	Lab course based on course MICMC 502	0	0	2	2	30	70	100
3	Major Elective (Any one)	MICML 503a/MICMR503b	Lab course based on course MICME 503a/503b	0	0	2	2	30	70	100
4	Major Elective (Any one)	MICML 504a/MICML504b	Lab course based on course MICME 504a/504b	0	0	2	2	30	70	100
Total				18	-	8	27	370	630	1000

L – Lecture, T – Tutorial, P – Practical, C – Credit

Sixth Semester

S. No.	**Course Category**	**Couse Code**	**Course Name**	**Periods**				**Evaluation scheme**		**Subject Total**
				L	**T**	**P**	**C**	**Sessional (Internal)**	**External (ESE)**	
Theory										
1	Major Core	MICMC 601	Environmental Microbiology	4	0	0	4	30	70	100
2	Major Core	MICMC 602	Infection& Immunity	4	0	0	4	30	70	100
3	Major Elective (Any one)	MICME 603a/MICMR603b	Genomics & Proteomics / Mushroom Technology /	4	0	0	4	30	70	100

4	Major Elective (Any one)	MICME604a/MICME604b	Bioanalytical Tool/Bioinformatics	4	0	0	4	30	70	100
5	Co-Curricular Course	COCCR-605	Medical Microbiology	2	0	0	0	30	70	100
6	Project 2	MICPE-606	Project/Educational Tour Report II	0	0	0	3	100	-	100
Practical										
1	Core	MICML 601	Lab course based on course MICMC 601	0	0	2	2	30	70	100
2	Core	MICML 602	Lab course based on course MICMC 602	0	0	2	2	30	70	100
3	Major Elective (Any one)	MICMEL 603a/MICMEL-603b	Lab course based on course MICME 603a/603b	0	0	2	2	30	70	100
4	Major Elective (Any one)	MICMEL604a/MICMEL-604b	Lab course based on course MICME 604a/604b	0	0	2	2	30	70	100
Total				18	0	8	27	370	630	1000

L – Lecture, T – Tutorial, P – Practical, C – Credit

Degree Course in Honours Microbiology (B.Sc. Hons.Microbiology)

Seventh Semester

S. No.	**Course Category**	**Couse Code**	**Course Name**	**Periods**				**Evaluation scheme**		**Subject Total**
				L	**T**	**P**	**C**	**Sessional (Internal)**	**External (ESE)**	
Theory										
1	Major Core	MICMC-701	Bacteriology	4	0	0	4	30	70	100

2	Major Core	MIC MC-702	Virology	4	0	0	4	30	70	100
3	Major Elective	MICME-703a/MICME703b	Microbial Analysis of air and water/Mycology	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE-704	Molecular Virology &Infection-I	2	0	0	2	30	70	50
5	Vocational	MICVO405	Pharmaceutical Biotechnology &Drug Designing	3			3	30	70	100
6.	Coc-uricular	COCCR-706	Biomedical Technology	2			2	30	70	100
Practical										
1	Major Core	MICML-701	Lab course based on course MICMC 701	0	0	2	2	30	70	100
2	Major Core	MIC ML-702	Lab course based on course MICMC 702	0	0	2	2	30	70	100
3	Major Elective	MICML703a/MICML703b	Lab course based on course MICME 703a/703b	0	0	2	2	30	70	100
Total				17	0	6	23	240	560	800

L – Lecture, T – Tutorial, P – Practical, C – Credit

Eight Semester

S. No.	**Course Category**	**Couse Code**	**Course Name**	**Periods**	**Evaluation scheme**					**Subject Total**
				L	**T**	**P**	**C**	**Sessional (Internal)**	**External (ESE)**	
Theory										

1	Major Core	MICMC-801	Epidemology	4	0	0	4	30	70	100
2	Major Core	MICMC802	Management of Human Microbial	4	0	0	4	30	70	100
3	Major Elective	MICME-803a/MICME803b	Nursing & Gardening / Biomaths, Biostats, Computers Programming & Applications	4	0	0	4	30	70	100
4	Minor/Open Elective	MICOE-804	Molecular Virology &Infection-II	2	0	0	2	30	70	50
5	Vocational	MICVO-805	Bioentrepreneurship	3	0	0	3	30	70	100
Practical										
1	Major Core	MICML801	Lab Course based on course MICMC 801	0	0	2	2	30	70	100
2	Major Core	MICML802	Lab Course based on course MICMC-802	0	0	2	2	30	70	100
3	Major Elective	MICMEL-803	Lab Course based on course MICME803a/803b	0	0	2	2	30	70	100
Total				17	0	6	23	240	560	800

L – Lecture, T – Tutorial, P – Practical, C – Credit

Degree Course in Microbiology with Research

Seventh Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
	Major Core	MICMC701	Research Methodology	4	0	0	4	30	70	100
	Major Core	MICMC 702	Research Publications and Ethics	4	0	0	4	30	70	100
Research										
	Research 1	MICRM 703	Review of literature/ Minor Project	0	0	0	10	60	140	200
	Research 2	MICRS 704	Research Seminar Presentation-I	0	0	0	5	50	50	100
Total				8	0	0	23	170	330	500

L – Lecture, T – Tutorial, P – Practical, C – Credit

Eight Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
	Major Core	MICRR- 801	Research –IPR	4	0	0	4	30	70	100
Research										
	Dissertation	MICMP- 802	Major Project/ Internship	0	0	0	14	60	240	300
	Research 3	MICRS 803	Research Seminar Presentation-II	0	0	0	5	50	50	100
Total				8	0	0	23	140	360	500

L – Lecture, T – Tutorial, P – Practical, C – Credit

Certificate Course in Microbiology

B. Sc. Microbiology

Course code	**:MICMC- 101**
Course Name	**: Introduction to Microbiology**
Semester	**: I**

L	T	P	C
4	0	0	4

Course Objective: The objective of course are

1.To knowledge about various type of Microorganism

2.To know about history and structure of Microorganism

Unit I: History of Microbiology **No. of Hours: 1**

Discovery of microorganisms; Spontaneous generation vs. biogenesis; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff and Edward Jenner; Golden era of microbiology; Scope of microbiology.

Unit II: Classification **No. of Hours: 05**

Kingdom classification of microorganisms: Haeckel's three kingdom concept, Whittaker's five kingdom concept, Six kingdom classification, Eight kingdom classification, Three domain concept of Carl Woese.

Unit III: Media and Pure Culture Techniques **No. of Hours: 12**

Culture media: Solid and liquid media, Synthetic and complex media, Enriched and enrichment media, Selective and differential media; Culture techniques for isolation of pure culture: Pour plating, Spread plating, Streaking, Enrichment culture technique; Maintenance and preservation of pure culture; Cultivation of anaerobic bacteria.

Unit IV: Acellular Microorganisms **No. of Hours: 08**

Characteristic features of viruses, prions and bacteriophage; Ultrastructure: Capsids, Types of envelope, Types and structure of genome; Cultivation of viruses and bacteriophage; Multiplication of viruses; Lytic and lysogeny cycle of λ phage.

Unit V: Cellular Microorganisms **No. of Hours: 25**

Bacteria: Morphology of bacteria, Structure and functions of cell wall, cell membrane, flagella, pili, ribosome, nucleoid, cytoplasmic inclusions and endospore; Fungi: General characteristics, Ultra structure and reproduction; Protozoa: General characteristics with special reference to *Amoeba* and *Paramaecium*; Algae: General characteristics.

Suggested Readings

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
4. Dimmoc, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
5. Primrose, S.B. Introduction to modern virology. John Wiley and Sons, New Jersey.
6. Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
7. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
8. Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.
9. Kannan, K. Laboratory manual in general microbiology. Panima, New Delhi.
10. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis.

CO 1	Write and describe about the History, scope of microbiology, classification of microorganisms ,culture media ,Cellular and acellular microorganisms

CO 2	Compare and differentiate between different scientists involved in microbiology, cellular and acellular microorganisms and will be able to explain classification and culture techniques.
CO 3	Illustrate and explain contribution of different scientists in field of microbiology, classification system, culture techniques and cellular and acellular microorganisms.
CO 4	Distinguish between cellular and acellular microorganisms, different culture techniques and will be able to explain classification system, history and scope of microbiology.
CO 5	Summarize about history, scope and classification of microorganisms and culture techniques and distinguish between cellular and acellular microorganisms.
CO 6	Develop generalized concept about microbiology.

B. Sc. MICROBIOLOGY

Course code	**: MICML 101**
Course Name	**: Lab Course Based on MICMC- 101**
Semester	**: I**

L	T	P	C
0	0	2	2

Practicals

1. Safety rules of working in microbiology lab.
2. Study of principle and applications of important instruments (autoclave, laminar air flow, hot air oven, microscope, incubator, inoculator, colony counter and vortex) used in microbiology laboratory.
3. Preparation of solid and liquid media.
4. Enumeration of total viable count in water/soil sample.
5. Isolation of pure culture of bacteria.
6. Differentiation between lactose fermentor and nonfermentor on Mac Conkey agar.
7. Study of colony morphology of *E. coli* on EMB agar.
8. Simple staining of bacterial cell.
9. Gram staining of bacterial cell.
10. Negative staining of bacterial cell.
11. Staining of fungal cell

CO 1	Memorize Safetyrulesofworkingand recognize different instruments used in microbiology Laboratory and enumeratetotalviablecountinwater/soilsample.
CO 2	Identify different types of bacteria and fungi on the basis of different staining techniques.
CO 3	Prepare different types of solid and liquid media.
CO 4	DifferentiatebetweenlactosefermentorandnonfermentoronMacConkeyagar.
CO 5	Assess characteristicfeaturesof*Aspergillus,Penicillium,Amoeba*and*Paramaecium* Andcolonymorphologyof*E.coli*onEMB Agar.

CO 6	Prepare isolationofpurecultureofbacteria.

B. Sc. MICROBIOLOGY

Course code	**: MICMC-102**
Course Name	**: Cell Biology**
Semester	**: I**

L	T	P	C
4	0	0	4

Course Objective: Course Objective: Cell is the structural and functional unit of life. It is often referred to as thebuilding block of life as well. The course on cell biology aims to impart knowledge of cellstructure and functions of diverse cellular organelles.

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UNIT-I (10 Periods)

Cell organization: Eukaryotic (plant and animal cell) and prokaryotic.

Plasma Membrane: Structure and functions. Fluid Mosaic Model.Solute transport across membrane.

Interactions- Adhesion junctions, tight junctions, gap junctions, and plasmodesmeta (only structural aspects)

UNIT II 15 Periods)

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III (20 Periods)

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

UNIT IV 10 Periods)

Signalling molecules and their receptors. Signal transduction. Pathways of intracellular receptors- cyclic AMP pathway, cyclic GMP and MAP kinase pathway

UNIT V (5 Periods)

Cell cycle and its regulation, Mitosis and Meiosis, Programmed Cell Death- Intrinsic and Extrinsic pathway

SUGGESTED READING AND TEXT BOOKS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress& Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Upon successful completion of the course a student will be able to

CO1	Define Intracellular Compartmentalization of Cell, cell signaling, replication, protein synthesis and cell cycle with reference to cell death.
CO2	Summarize the types of cell organelles and cell signaling , mode of replication , transcription and Translation process in cell, Gene regulation , Mitosis and meiosis ,types of cell death.
CO3	Explain the various cell organelles and function, method of signaling, Evidence and mechanism of Replication, protein synthesis in Prokaryotes and Eukaryotes, Types of cell division and cell death.
CO4	Explain Structure ,organization and functions of cell organelles, process of cell signaling ,Protein synthesis process in Prokaryotes and Eukaroyes, Types of Gene Regulation,
CO5	Summarize the function of cell organelles, role of signal molecule in cell,Protein synthesis in Pro-and Eukaroytes with post transcriptional and translational modification.Control of gene expression .Phases of cell cycle and mechanism of cell death.
CO6	Justify cell organelles, cell cycle , signaling ,protein synthesis and gene regulation and cell death.

Course code	**:MICML102**
Course Name	**:Lab Course Based on MIMC 102**
Semester	**: I**

L	T	P	C
0	0	2	2

Practicals

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Studytheworkingandfunctioningof microscope.
3. Demonstration of dialysis.
4. Study of plasmolysis and de-plasmolysis.
5. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
6. Study of structure of any Prokaryotic and Eukaryotic cell.
7. Cell division in onion root tip.

CO1	Identify different stages of cell cycle.
CO2	Identify and determine the enzyme activity in organells..
CO3	Demonstrate the process of mutagenesis, photoreactivation, transformation and conjugation.
CO4	Analyze and study of structure of any Prokaryotic and Eukaryotic cell.
CO5	Estimate the quantity of DNA
CO6	Prepare slides of mitosis and meiosis.

B. Sc. MICROBIOLOGY

Course code	**: MICME 103a**
Course Name	**:BIOCHEMISTRY**
Semester	**: I**

L	T	P	C
4	0	0	4

Course objectives:

CourseObjectives:Theobjectivesofthiscourseare

1. Tounderstandtheprinciplesofbioenergeticsand enzyme catalysis

2. Togainknowledgeabout natureofbiologicalmacromoleculessuchasproteins,lipidsandcarbohydrates.

CourseContents

TOTALHOURS:60 **CREDITS:04**

UnitI:Bioenergetics No.ofHours:08

Firstandsecond laws of thermodynamics; Definitions of Gibb's free energy, enthalpy and entropy andmathematical relationship among them; Standard free energy change and equilibrium constant;Coupled reactions and additive nature of standard free energy change; Energy rich compounds:Phosphoenolpyruvate,1,3-Bisphosphoglycerate,Thioesters,ATP.

UnitII:Carbohydrates No.ofHours:12

Familiesofmonosaccharides:Aldosesandketoses,Trioses,Tetroses,Pentoses,Hexose Stereoisomerismofmonosaccharides;Epimers;Mutarotationandanomersofglucose;Furanoseandpyranoseformsofglucoseandfructose;Haworthprojectionformulaeforglucose;Chairandboatformsofglucose;Disaccharides;Conceptofreducingandnon-reducingsugars;Storagepolysaccharides:Starch,Glycogen;Structuralpolysaccharides:Cellulose,Peptidoglycan,Chitin.

UnitIII:Lipids No.ofHours:12

Definitionandmajorclassesofstorageandstructurallipids;Storagelipids;Fattyacids:Structureandfunctions,Essentialfattyacids;Triacylglycerols:Structure,functionsandproperties;Saponification;Structurallipids;Phosphoglycerides:Buildingblocks,Generalstructure,functionsandproperties;Introductionoflipidmicelles,monolayersandbilayers.

UnitIV:ProteinNo.ofHours:15

Structures of proteins: Amino acids, General formula of amino acid and concept of zwitterion,Titration curve of amino acid and its significance, Classification, biochemicalstructureandnotationofstandardproteinaminoacids,Ninhydrinreaction,Introductiontosecondary,tertiaryandquaternarystructuresofproteins;Functionsofproteins.

UnitV:EnzymesNo.ofHours:13

Structure of enzyme: Apoenzyme and cofactors, Prosthetic group-TPP, coenzyme NAD, metalcofactors; Classification of enzymes; Mechanism of action ofenzymes: Active site, transitionstate complex and activation energy, Lock

andkey
hypothesis,Inducedfithypothesis;Enzymekinetics:Significanceofhyperbolic,double reciprocalplotsofenzymeactivity,Km,andallostericmechanism;Definitionsofterms: Enzymeunit,Specificactivity,Turnovernumber.

TextBooks:

- **JainJ.L()Biochemistry**
- **Campbell,M.K.(2012)Biochemistry.CengageLearningPublishers,7thed**

ReferenceBooks:

- **Campbell,P.N.andSmith,A.D.(2011).BiochemistryIllustrated.ChurchillLivingstone,London,4 thed.**
- **Tymoczko,J.L.,Berg,J.M.andStryer,L.(2012).Biochemistry:Ashortcourse,W.H.Freeman andCompany, 2nded.**
- **Berg,M.,Tymoczko,J.LandStryerL.(2011)Biochemistry.W.H.Freemanand**
- Company,New York.
- Nelson,D.L.andCox,M.M.(2008).Lehningerprinciplesofbiochemistry.W.H.FreemanandCompany, NewYork,5thed.
- Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein'sMicrobiology.McGraw-Hill,NewYork,9thed.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Define basics of bioenergetics, carbohydrates, proteins, lipids and enzymes
CO 2	Explain and describe different terminology used in bioenergetics and classify and compare types of biomolecules.
CO 3	Illustrate and develop an understanding about families of carbohydrates, storage and structural lipids, proteins, enzymes and its mechanisms.
CO 4	Explain bioenergetics, biomolecules and enzymes.
CO 5	Compare and summarize between biomolecules and enzymes
CO6	Create structure of biomolecules and express an understanding of bioenergetics, biomolecules and enzymes

B. Sc. MICROBIOLOGY

Course code	**: MICMEL 103a**
Course Name	**:Lab based on MICMC-103a**
Semester	**: I**

L	T	P	C
0	0	2	2

CourseObjectives:Theobjectivesofthislabcourseare

TOTALHOURS:60 **CREDITS:02**

1. Propertiesofwater,conceptofpHandbuffers,preparationofbuffersandnumericalproblemsto explaintheconcepts.
2. Standardfreeenergychangeofcoupledreactions.
3. Qualitativetestsforcarbohydrates,reducingsugarsandnon-reducingsugars.
4. Qualitativetestsforlipidsandproteins.
5. Studyofproteinsecondaryandtertiarystructureswiththehelpofmodels.
6. Studyofenzymekinetics–calculationofVmax,Km,Kcatvalues

CO 1	Define safety rules of working in lab
CO 2	Estimate quantitatively and qualitatively sugar
CO 3	Preparation of media
CO 4	Calculation of moles
CO 5	Estimate the qualitative test of protein.
CO6	Write and design the study of protein structure by SPVD model .
CO 1	Define safety rules of working in lab
CO 2	Estimate quantitatively and qualitatively sugar
CO 3	Preparation of media
CO 4	Calculation of moles
CO 5	Estimate the qualitative test of protein.
CO6	Write and design the study of protein structure by SPVD model .

B. Sc. MICROBIOLOGY

Course code	**: MICME 103b**
Course Name	**: Plant Physiology**
Semester	**: I**

L	T	P	C
4	0	0	4

CourseObjective:Theobjectivesofthecourseareasfollows:

1. Toprovidedetailedinformationaboutthebasicprinciplesofplantfunction
2. Toteachtheplant-waterrelationships
3. Toteachprinciplesofplantcellphysiologyandplantgrowthanddevelopment
4. Toteachcarbonandnitrogenmetabolism
5. Toprovideinformationaboutplantsecondarymetabolitesandtheirroleinplantstressphysiology

UNIT I: Anatomy (10 Periods)

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

UNIT II: Plant water relations and micro & macro nutrients (12 Periods)

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

UNIT III: Carbon and nitrogen metabolism (20 Periods)

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation pointinorganic& molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT IV: Growth and development (18 Periods)

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization

SUGGESTED READING AND TEXT BOOK

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Identify and define the terms and basic concepts of plant physiology and their different roles to influencebiological plant body systems.
CO2	Explain the principle, mechanism of Anatomy, Plant water relations and micro & macro nutrients, Carbon and nitrogen metabolism andGrowth and development.
CO3	Determine thedetailedprocessesofAnatomy, Plant water relations and micro & macro nutrients, Carbon and nitrogen metabolism andGrowth and development.
CO4	Focus on the concept of plant Anatomy, Plant water relations and micro & macro nutrients, Carbon and nitrogen metabolism andGrowth and development.
CO5	Summarize about theprinciple, methods, properties and functions of plant physiology.
CO6	Generalize the plant physiology and the awareness andappreciationforplantsinenvironment,andtheirdiversephysiologicalfunctions.

B. Sc. MICROBIOLOGY

Course code	**: MICMEL 103b**
Course Name	**: Lab course based on 103b**
Semester	**: I**

L	T	P	C
2	0	0	2

1. To determine the osmosis ,diffusion technique.

2. To study a plant anatomy.

3. To study the plant growth and function.

4.A study of plant root T.S by Microscope.

4.A study of plant stem T.S by Microscope.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Identify study a plant anatomy.
CO2	Explain growth and developmentof plant
CO3	Determine the detailedprocessesofAnatomy, Plant water relations and micro & macro nutrients, Carbon and nitrogen metabolism andGrowth and development.
CO4	Focus on the concept of plant Anatomy, Plant water relations and micro & macro nutrients, Carbon and nitrogen metabolism andGrowth and development.
CO5	Summarize about the principle, methods, properties and functions of plant physiology.
CO6	Generalize the plant physiology and the awareness andappreciationforplantsinenvironment,andtheirdiversephysiologicalfunctions.

B. Sc. Microbiology

Course code : MICOE 104

L	T	P	C
2	0	0	2

Course Name :Introduction and Scope of Microbiology-I

Semester : I

TOTAL HOURS: 30

CREDITS: 02

Course Objective

1.To knowledge about history and structure of Microorganism.

2.To understand about Microscope functions and sterilization Technique.

No of Hours-15

Unit I

An Introduction to Microbiology, biogenesis*vs*. abiogenesis. Contributions ofAntonyvan Leeuwenhoek, Louis Pasteur,RobertKoch, JosephLister, AlexanderFleming, Edward Jenner.General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) andCellular microorganisms (Prokarya: Archaea and Bacteria, Eukarya: Algae, Fungi and Protozoa)givingdefinitions and Morphology.

Unit IINo of Hours-15

MoistHeat,Autoclave,DryHeat,HotAirOven,Tyndallization,Filteration.BrightFieldMicroscope,Dark FieldMicroscope,PhaseContrastMicroscope,FluoresenceMicroscope,TransmissionElectronMicrosc ope, ScanningElectronMicroscope.

SUGGESTED READING AND TEXT BOOKS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress& Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

CO 1	Write and describe about the History, scope of microbiology, classification of microorganisms Cellular and acellular microorganisms
CO 2	Compare and differentiate between different scientists involved in microbiology, cellular and acellular microorganisms and will be able to explain classification .
CO 3	Illustrate and explain contribution of different scientists in field of microbiology, classification system, culture techniques and cellular and acellular microorganisms.
CO 4	Distinguish between cellular and acellular microorganisms, different culture techniques and will be able to explain classification system, history and scope of microbiology.
CO 5	Summarize about history, scope and classification of microorganisms and culture techniques and distinguish between cellular and acellular microorganisms.
CO 6	Develop generalized concept about microbiology.

B. Sc. Microbiology

Course code : **MICVO- 105**

Course Name :**MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES**

L	T	P	C
3	0	0	3

Semester : **I**

TOTAL HOURS: 60

CourseObjectives:Theobjectivesofthiscourseare

1. Toinculcateinstudentsgoodandsafelaboratorypractices

2. Todetermineandexaminemicrobesinfoodandpharmaceuticalsamplesbydifferent Culturalandmicroscopicmethods.

3. Tocreateawarenessregardingfoodsafety ,qualityassuranceandvalidation.

CourseContents

TOTALHOURS:60 **CREDITS:02**

UnitI:MicrobiologicalLaboratoryandSafePractices

Laboratorypractices:Goodlaboratorypractices,Goodmicrobiologicalpractices;Biosafety cabinets: Working ofbiosafety cabinets, Specification for BSL-1,BSL-2,BSL-3; Discardingbiohazardouswaste:Methodologyofdisinfection,autoclavingandincineration, sterilizationand preservation method of microorganism.HACCP for food safety,QA and QC.

UnitII:DeterminingMicrobesinFood/PharmaceuticalSamples

Cultureandmicroscopicmethods:Standardplatecount,Mostprobablenumbers,Direct Microscopiccounts;Biochemical,immunologicalandmolecularmethods of detection; Limuluslystestforendotoxin;Biosensors;microbialqualityofmilk byMBRT:Rapid detection detectionmethodsofmicrobiologicalqualityofmilkatmilkcollectioncenters(COB,10minResazurin assay).Enrichmentculturetechnique;DetectionofspecificmicroorganismsonXLDagar,Salmonella Shigellaagar,Manitolsaltagar,EMBagar,MacConkeyagarandSaboraudagar,Blood Agar.Triple Sugar Iron Agar .

TextBooks:

TB1. Jay,J.M.,Loessner,M.J.andGolden,D.A.(2005).Modernfoodmicrobiology.S pringerPublishers,NewYork,7thed**.**

ReferenceBooks.

RB1. Harrigan,W.F.(1998).Laboratorymethodsinfoodmicrobiology.AcademicPress,3rded.

RB2. Garg,N.,Garg,K.L.andMukerji,K.G.(2010).Laboratorymanualoffoodmicrobiology I.K.InternationalPublishingHousePvt.Ltd.,NewDelhi.

RB3. Baird,R.M.,Hodges,N.A.andDenyer,S.P.(2005).Handbookofmicrobiologicalquality controlinpharmaceuticalandmedicaldevices.TaylorandFrancisInc

Uponsuccessfulcompletionofthecourseare studentwillbeableto

CO 1	Define good and safe microbiological practices in food and Pharmaceutical Industries.
CO 2	Represent different method to determine microbes, pathogenic microorganisms in food, pharmaceutical and water samples. .
CO 3	Discover pathogenic microorganisms from food and water sample.
CO 4	Explain about different microbial standard for different food and water sample.
CO 5	Practice good laboratory practices .
CO6	Express about quality control and quality assurance and validation.

B. Sc. Microbiology

Course code	**:COCCR-106**
Course Name	**:Environmental Science**
Semester	**: I**

L	T	P	C
2	0	0	0

Course Objective: The basic objective of the environmental studies is to enable the students forinterdisciplinary approach to complex environmental problems using basic tools of the natural andsocial sciences including ecosystem, geosystems, biology, chemistry and global process. They willacquire an attitude of concern for the environment and will be able to critically evaluate the scienceandpolicyramificationsofdiverseportfoliosonairandwaterquality,naturalresources etc.

Unit1:IntroductiontoEnvironmentalSciences and Ecosystems

Multidisciplinary nature of Environmental Sciences; Scope and importance; Concept ofsustainabilityand sustainable development.Whatisanecosystem?Structureandfunctionofecosystem;Energyflowinanecosystem:foodchains,foodwebsandecologicalsuccession.

Unit2:Renewableand Non-renewableResources/Biodiversity andConservation

Land resourcesandlandusechange;Landdegradation,soilerosionanddesertification.

Deforestation, Water.Energy resources: Renewable and non renewable energy sources, use of alternate energysources,growingenergyneeds, casestudies.Levels of biological diversity : genetic, species and ecosystem diversity; BiogeographiczonesofIndia;Biodiversitypatternsandglobalbiodiversityhotspots,Indiaasamega-biodiversity nation.

Unit3:EnvironmentalPollution/HumanCommunitiesandtheEnvironment

Environmental pollution.Climate change, global warming, ozone layer depletion, acid rain and impacts on humancommunities and agriculture. Disaster management:floods,earthquake,cyclonesandlandslides.Environmentalmovements:Chipko,Silent valley,Bishnois of Rajasthan. Environmentalethics:RoleofIndianandotherreligionsandculturesinenvironmentalconservation.Environmentalcommunicationandpublicawareness,casestudies(e.g.,CNGvehiclesinDelhi).

SUGGESTED READING AND TEXT BOOKS

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R).

3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).

4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental

CO	Descriptin
CO1	Define the terms and basic con cepts of environmental biology and their different roles toinflencebiologicalsystems.
CO2	**Explaim**the principle, mechanism of air pollution, water pollution and methods to control.
CO3	**Illustrate** processesofenvironmental biology and their different roles to inflencebiologicalsystems.
CO4	**Explain** thedetailedprocessesofstructureandfunctionofenvironmental biology and their different roles toinflencebiologicalsystems. Biodiversity, ecosystem and Global Environmental Problems.
CO5	**Compare** the principle, methods, properties and functions of environmental biology and their different roles to inflencebiologicalsystems. Biodiversity, ecosystem and Global Environmental Problems.
CO6	**Create a**environmental biology and their different roles to inflencebiologicalsystems. Biodiversity, ecosystem and Global Environmental Problems.

B. Sc.Microbiology

Course code	**:MICMC 201**
Course Name	**:IMMUNOLOGY**
Semester	**: II**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. **To gain knowledge of immune system.**
2. **To gain knowledge of Antigen structure and properties.**
3. **To make the student aware Tumour immunology.**

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

Unit I: Introduction to immune systemNo. of Hours: 10

History of immunology, composition and functions of cells and organs involved in immune system; Immune response and its type- innate (non specific), acquired (cell mediated and humoral) immunity. Cytokines.

Unit II: Antigens and Antibodies

No. of Hours: 15

Antigens- structure and properties, Antigenicity and Immunogenicity, Immunoglobulin- structures, properties & functions and types. Monoclonal antibodies.

Unit III: **Immunological Techniques**

No. of Hours: 10

ELISA, RIA, Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, Western blotting, Immunofluoresence,complement fixation and Flow cytometry,

UNIT-IV: **Complement system and Major Histocompatibility Complex**

No. of Hours: 12

Complements- Structure, functions and Complement pathways (Classical and Alternative)
Major Histocompatibility Complex (MHC): Structure and functions. Transplantation and its types.

.

Unit V: **Immunopathology**

No. of Hours: 13

Autoimmunity and autoimmune disorders ((Rheumatoid arthritis, Hashimoto's thyroiditis) Vaccines, Hypersensitivity reactions and its types.

.

Text Books:

1. Delves,P.J.,Martin,S.J.,Burton,D.R.andRoitt,I.M.Roitt'sessentialimmunology.Wiley-Blackwell, New Jersey**.**
2. Abbas,A.K.,Lichtman,A.H.H.andPillai,S.Cellularandmolecularimmunology.Saunders,Philadelphia.

Reference Books

1.Kindt, T.J., Goldsby, R.A., Osborne, B.A. and Kuby, J. Kuby immunology. W.H. Freeman and Company, New York.

2. Chakrabarty. Immunology &Immunotechnology. Oxford

3.Male, D.K. Immunology: An illustrated outline. Elsevier Health Sciences, Philadelphia.

4.Abbas, A.K. and Lichtman, A.H.H. Basic immunology: Functions and disorders of the immune system. Saunders, Philadelphia.
5.Rao, C.V. Immunology. Alpha Science International, New Delhi.

6. Pathak, S. and Palan, U. Immunology: Essential and fundamental. Science, New Hampshire.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the terms used in immune system, Antigen and antibody,complement system and MHC, immune response and medical applications of immunology**.**
CO2	Discuss and differentiate between cells of the immune system,types of immunity and immune response, antigens and antibodies. Explain role of complement system in immune response, MHC and medical applications of immunology**.**
CO3	Write about the basic concept of immunity and immune system, Explain with diagrams antigen –its properties, types and functions and antibodies, its types and functions, complement component, pathways etc.MHC, Transplantation, immune response and regulation and immunopathology.
CO4	Illustrate and diagrammatically explain cells of the immune system, Explain types of immunity and immune response, concept of antigen and antibodies,MHC ,complement system and its activation pathways, transplantation, immune response and regulation and medical applications of immunology.
CO5	Summarize along with diagrams the concept of immune system, antigens, antibodies, complement system and MHC, transplantation, immune response and

	regulation and medical applications of immunology**.**
CO6	Generalize the concept of Immunology

B. Sc.Microbiology

Course code	**:MICML 201**
Course Name	**:IMMUNOLOGY**
Semester	**: II**

L	T	P	C
2	0	0	2

1. Separation and preservation of serum andplasma.
2. Determination of blood group and Rhfactor.
3. Demonstration of agglutination reaction of bacterial cultures by slide agglutinationtest.
4. Quantitative estimation of antigen by radialimmunodiffusion.
5. Detectionandquantificationofeitherantibodyorantigenbydoublediffusionmethod.
6. Determination of concentration ofantigen byrocket immune electrophoresis.

CO	Description
CO1	Define preservation of serum and plasma.

7. Determination of the presence of specific antibody for its antigen by Dot-ELISAmethod. Separation of components of antigen mixture and study the patternbyimmuno electrophoresis.

CO2	Explain and determination of blood group and Rhfactor
CO3	Explain demonstration of agglutination reaction of bacterial cultures by slide agglutinationtest
CO4	Explain Separation of components of antigenmixture and study the patternbyimmuno-electrophoresis
CO5	**Summarize the** preservation and determination of blood group and Rhfactor
CO6	Create preservation of serum and plasma

B. Sc. Microbiology

Course code	**:MICMC-202**
Course Name	**:Microbial Physiology &Metabolism**
Semester /Year	**: II**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. **To gainknowledgeof various transportsystemsandproteinsecretionpathwaysinbacteria**
2. **To make student awarethe concept osmoregulation.**
3. **To Gain knowledge of Quorum sensing.**

No. of Hours: 11

Unit I: Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth; Batch culture; Continuous culture; Generation time and specific growth rate; Temperature and pH ranges of growth; Effect of solute and water activity on growth; Effect of oxygen concentration on growth; Nutritional categories of microorganisms.

1. **Unit II: Nutrient Uptake and Transport** **No. of Hours: 10**
   Passive and facilitated diffusion Primary and secondary active transport; Concept of uniport, symport and antiport; Group translocation; Iron uptake.

2. **Unit III: Chemoheterotrophic Metabolism** **No. of Hours: 18**
   Concept of aerobic and anaerobic respiration; Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle; Fermentation: Alcohol fermentation and Pasteur effect, Lactate fermentation (Homofermentative and heterofermentative pathways), Concept of linear and branched fermentation pathways; Electron transport chain: Components of respiratory chain, Comparison of mitochondrial and bacterial ETC, Electron transport phosphorylation, Uncouplers and inhibitors.

Unit IV: Chemolithotrophic and Phototrophic Metabolism **No. of Hours: 10**

3. Chemolithotrophic metabolism: Introduction to aerobic and anaerobic chemolithotrophy with an example each, Hydrogen oxidation (Definition and reaction), Methanogenesis (Definition and reaction); Phototrophic metabolism: Introduction, Groups of phototrophic microorganisms, Anoxygenic *vs.* oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria.

4. **Unit V: Nitrogen Metabolism** **No. of Hours: 10**
   An overview, Introduction to biological nitrogen fixation, Ammonia assimilation, Assimilatory nitrate reduction, Dissimilatory nitrate reduction (Denitrification, nitrate/nitrite and nitrate/ammonia respiration, fermentative nitrate reduction).

Text Books:

1. Foster, J.W. and Spector, M.P. Microbial physiology. John Wiley and Sons, New York

2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, NewYork
3. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley andKlein'smicrobiology. McGraw-Hill, NewYork.

Reference Books:

1. Foster, J.W. and Spector, M.P. Microbial physiology. John Wiley and Sons, New York.
2. Madigan,M.T.,Martinko,J.M.andParker,J.Brockbiologyofmicroorganisms.PrenticeHall, NewJersey.
3. Brun, Y.V. and Shimkets, L.J. Prokaryotic development. ASM Press, Washington, D.C.
4. Rose, A.H. Advances in microbial physiology. Academic Press, New York.
5. David,W.,Drummond,J.T.andFuqua,C.Physiologyandbiochemistryofprokaryotes.Oxford University Press, New York.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Define the terminology related to Microbial Growth and Effect of Environment on Microbial Growth,Nutrient Uptake and Transport, Chemoheterotrophic Metabolism,Chemolithotrophic and Phototrophic Metabolism,Nitrogen Metabolism.
CO 2	Discuss about Microbial Growth and Effect of Environment on Microbial Growth, Nutrient Uptake and Transport, Chemoheterotrophic Metabolism, Chemolithotrophic and Phototrophic Metabolism, Nitrogen Metabolism
CO 3	Explain and illustrate diagrammatically where required about Growth, Growth kinetics and effect of different parameters on growth, diffusion, group translocation and iron uptake, Chemoheterotrophic Metabolism, Chemolithotrophic and Phototrophic Metabolism, Nitrogen Metabolism.
CO 4	Explain and focus on the concept of growth kinetics, active and passive transport,Concept of aerobic and anaerobic respiration, Chemolithotrophic and Phototrophic Metabolism, Nitrogen Metabolism.
CO 5	Summarize about growth, Nutrient Uptake and Transport, Chemoheterotrophic Metabolism, Chemolithotrophic and Phototrophic Metabolism, Nitrogen Metabolism
CO6	Generalize the concept of Microbial Physiology and Metabolism

B. Sc. Microbiology

Course code	**:MICML-202**
Course Name	**:Microbial Physiology &Metabolism**
Semester /Year	**: II**

L	T	P	C
0	0	2	2

CREDITS:02

CourseObjectives:Theobjectivesofthislabcourseare

1. Togetawarenessabouthowtocheckthe effect to temperatureandpHonthegrowthofbacteriaandhowtoplotthegrowthcurve.

2. Tounderstand andhowtocalculategenerationtimeandspecificgrowthrateofBacteria.

1.Study and plot the growth curve of *E. coli* by tubidiometric and standard plate countmethods**.**

2.Calculationsofgenerationtimeandspecificgrowthrateofbacteriafromthegraphplottedwi ththegivendata.

3.Effectoftemperatureongrowthof*E.coli*.

4.EffectofpHongrowthof*E.coli*.

Uponsuccessfulcompletionofthelabcourseastudentwillbeableto

CO 1	Study and plot the growth curve of *E. coli* by tubidiometric method.
CO 2	Observe the effect of temperature on growth of *E. coli*.
CO 3	Effect of pH on growth of *E. coli*.
CO 4	Illustrate the growth curve of *E. coli* by standard plate count methods.
CO 5	Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
CO6	Evaluate the effect of solute and water activity on growth.

B. Sc.Microbiology

Course code	**: MICMC-203a**
Course Name	**: Biological Technique**
Semester	**: II**

L	T	P	C
4	0	0	4

Course Objectives:The objectivesof this course are

. 1.To aware the student to principle of pH meter.
2.To learn about principle and applications of various electrophoretic techniques.
3.To learn about spectroscopy and radioisotopic technique.

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

Unit I: Chromatography

No. of Hours: 8

Principles and applications of paper chromatography, Thin layer Chromatography, Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC.

Unit II: **Spectrophotometry** **No. of Hours: 7**

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Unit III:Electrophoresis **No. of Hours: 10**

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Agarose gel electrophoresis

Unit IV: Centrifugation No. of Hours: 10

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

Unit V:Microscopy **No. of Hours: 10**

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Text Books:

1. Wilson K and Walker J. Principles and Techniques of Biochemistry and MolecularBiology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. Lehninger Principles of Biochemistry, 5th Ed., W.H.Freeman and Company.
3. De Robertis EDP and De Robertis EMF. Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Stanley R. Maloy, John E. Cronan, David Frielfeder. Mivrobial Genetics.

NarasoPublishing House.
5. R.C. Dubey and D.K. Maheshwari. Textbook of Microbiology. S.Chand & Co. Ltd.

Reference Books:

1. Sawhney, S.K. and Singh, R. Introductory practical biochemistry. Narosa PublishingHouse, NewDelhi.
2. Segel, I.H. Biochemical calculations. John Wiley and Sons, New York.
3. Plummer, D.T. Introduction to practical biochemistry. Mc-Graw Hill, New York.
4. Boyer, R.F. Modern experimental biochemistry. Prentice Hall, New Jersey.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define b**asic** principle of laboratory Instruments**,** Microscopy and Biosensors, Chromatography electrophoresis, Spectroscopy and Radioisotope.
CO2	Summarize the principals and function of laboratory Instruments Microscopy and Biosensors Theory, principle and applications of chromatography, Basic principles and applications of electrophoresis and spectroscopy. Applications of radioisotopes in biology
CO3	Explain application and principle of laboratory instruments, Introduction and principles of Microscopy and biosensors, Theory, principle and applications of chromatography, Basic principles and applications of electrophoresis, Elementary idea of spectroscopy. Radiotracer techniques.
CO4	Explain principles of Instruments, Types of biosensor and Microsopy, principle and applications of electrophoresis, principle and applications of radioisotopes.
CO5	Summarize the principles and types of Ph meter, Laminar air flow and centrifugation., Applications of radioisotopes in biology
CO6	Justify basic laboratory Instrumentsfunction of microscopy and biosensor,principle and applications of chromatography **,** Applications of radioisotopes in biology.

B. Sc. Microbiology

Course code	**: MICML-203a**
Course Name	**: Biological TechniqueLab course based on 203a**
Semester	**: II**

L	T	P	C
2	0	0	2

PRACTICALS

1. Separation and identification of amino acids by ascending anddescendingpaperchromatography.
2. Separation and identification ofsugars bypaperchromatography.
3. Separation and identification of sugarsbythin layerchromatography.
4. Verification of Lambert Beer'slaw.
5. Determination of molecular weight ofDNA byagarose gelelectrophoresis.
6. Separation and determination of molecular weight of proteins bySDS-PAGE.

Upon successful completion of the course a student will be able to

CO1	Know separation and identification of amino acids and sugars by different chromatographic techniques.
CO2	UnderstandthetechniquesforintroductionofDNAintohostcellsand study its expression.
CO3	Gain knowledge of amplification of DNA by PCR
CO4	Learn to perform restriction digestion of DNA; RFLP
CO5	Learn to isolate genomic and plasmid DNA

B. Sc.Microbiology

Course code	**: MICME 203b**
Course Name	**:Basics of Forensic Science**
Semester	**: II**

L	T	P	C
4	0	0	4

Courseobjectives: Thisisanintroductorycourseonforensicsciences withthefollowingobjectives:

1. Tofamiliarizestudentswiththefundamentalprinciplesofforensicsciences.
2. Toimpartknowledge abouttheinjuriesanddeathsandhowtheyareassessed.
3. Tomakestudentsunderstandthe process ofdocumentation .
4. Toimpartheknowledgeabouttheir importanceofcybersecurityinforensicsciences.

Unit I (15 Periods)

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II (15 Periods)

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit III (15 Periods)

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,

Unit IV (15 Periods)

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

SUGGESTED READING AND TEXT BOOKS

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001). _
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002). _
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. **W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene** Investigation, CRCPress, Boca Raton (2013).

COURSE OUTCOMES(CO): Oncompletionofthiscourse,thestudentswillbeableto:

CO	Description
CO1	**Remember**about different facets of forensics.
CO2	Remember and Understand the concept of forensic science including fringerprinting,toxicology and fire arm and explosives.
CO3	Explain the concept of forensic science including fringerprinting,toxicology and fire arm and explosives.
CO4	Explain forensic science laboratory and its organization and branches of forensic science,Concept of fire arms and explosives ,fingerprinting and toxicology and will be able to compare handwritings and analyse ink various samples.
CO5	Summarize fundamental basics of forensic science and fingerprinting
CO6	Develop generalized concept of forensic science.

B. Sc. Microbiology

Course code	**: MICML 203b**
Course Name	**:Lab Course Based on MICMC203b**
Semester	**: II**

L	T	P	C
0	0	2	2

Practicals

1. Study of Crime Scene Investigation: Safeguarding, Searching, Recognition, Documentation, Collection, Packaging, and Preservation of Physical Evidence
2. Study of Trace Evidence Collection and Sorting.
3. Study of Examination of Human Hair.
4. Study of Examination of Trace Quantities of Synthetic Fibers.
5. Case Studies

COURSE OUTCOME(CO): Uponsuccessful completion ofthiscoursethestudentwill:

1. ApplytheLaboratoryskilltoparticipateinthecareerneedsofForensiccommunity.
2. BecometrainedinthelaboratoryskillsoftdifferentdivisionofForensicScience.
3. BeabletoworkwithdifferentR&Dorganizations.
4. Learn abouttheknowledgeabouttheimportanceofcybersecurityinforensicsciences.

COURSE OUTCOMES(CO): One completionofthiscourse ,thestudentswillbeableto:

CO	Description
CO1	Rememberabout different facets of forensics.
CO2	Remember and Understand the concept of forensic science including finger printing, toxicology and fire arm and explosives.
CO3	Explain the concept of forensic science including finger printing ,toxicology and fire arm and explosives.
CO4	Explain forensic science laboratory and its organization andbranches of forensic science,Concept of fire arms and explosives fingerprinting and toxicology and will be able to compare handwritings and analyze various samples.
CO5	Summarize fundamental basics of forensic science and fingerprinting.
CO6	Develop generalized concept of forensic science.

B. Sc.Microbiology

Course code	**: MICOE-204**
Course Name	**: Introduction and scope of Microbiology-II**
Semester	**: II**

L	T	P	C
2	0	0	2

CourseObjectives:Theobjectivesofthiscourse are

1.To gain knowledge about application of Microorganism.
2.To make student aware about various branch of Microorganism.

3.To gain knowledge about Food born Infection.

Course Content
UNIT –I Definitionoffermentation,primaryandsecondarymetabolites,typesof fermentationsandfermenters and microbes producingimportantindustrialproducts throughfermentation.

UNIT-II Microorganisms as food (SCP), microorganisms in food fermentations (dairy and non-dairy based fermented foods) and probiotics. Microorganisms in food spoilage and food borne infections.

Text Books:

1. **Tortora,FunkeandChase(2006).*MicrobiologyAnIntroduction*(9thed.).BenjaminCummings.ISBN 13: 9780321733603**
2. **Stanier,Ingraham,Wheelis.(1987)*GeneralMicrobiology*(5thed.).MacMillan.ISBN-13:978-0333417683**
3. **Weaver, R. F. (2012). *Molecular biology*. New York: McGraw-Hill. ISBN 0072345179.**
4. **P.S.VermaandV.K.Agarwal(2008).*Cellbiology,Genetics,MolecularBiology,Evolution and Ecology*. S. Chand & Company Ltd ISBN: 81-219-2442-1.**
5. **H Lodish*et* al, (2016). *Molecular Cell Biology*. 8/e, Freeman, ISBN 9781464183393.**
6. **Lehninger(2009).*PrinciplesofBiochemistry*.W.H.Freeman;(6thed).ISBN:071677108X**
7. **Lewin,B.,(2004).*GenesVIII*.InternationalEdition,PearsonEducationInternational,ISBN0131238264**

Reference Books:

1. GMCooper&REHausman.(2016).*TheCell-AMolecularApproach.*7/e.ISBN978-1-60535-290-9.
2. JDWatson.(2013).*MolecularBiologyoftheGene*,7/e.Pearson.ISBN978-0321762436.
3. Benjamin Lewin, *Genes IX*. (2008). Publisher: J&B ISBN:0763752223

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define the terms related to fermentation, its types and microbes involved in production of industrial products, Microbes as food , food fermentation, food spoilage and food infection.
CO2	Discuss the role of microbiology and microorganisms in fermentation and food, food borne infection and spoilage.
CO3	Write about the concept of fermentation, its types and microbes in fermentation, role of microbes in food industry.
CO4	Explain fermentation, its types and microbes in fermentation, role of microbes in food industry.
CO5	Summarize the concept of fermentation and food industry and role of microbes.
CO6	Generalize about microbes in fermentation, role of microbes in fermentation products and microbes and their role in food industry.

B. Sc.Microbiology

Course code	**: MICVC 205**
Course Name	**: MICROBIAL GENETICS**
Semester	**: II**

L	T	P	C
3	0	0	3

Course Objectives:The objectives of this course are

1. To understand the concept of genes.
2. To make student aware of mechanism of gene exchange in bacteria.
3. To gain knowledge about Mutation and Transposable Elements.

Course Content

TOTAL HOURS: 60 **CREDITS: 03**

Unit I: Essentials of Genetics **No. of Hours: 8**

Genetic notations, Units of gene, Mutation and types of mutation, Spontaneous and induced mutations, molecular nature of mutation

Unit II: Plasmids **No. of Hours: 7**

Bacterial plasmids: Types of plasmids, Fertility or F plasmid, resistance or R plasmid, col plasmid,

degradative plasmid and virulence plasmids, plasmid replication, plasmid incompatibility, plasmid copy number, plasmid curing, plasmid amplification

Unit III: Mechanism of Gene transfer **No. of Hours: 10**

Transformation: Competence, Competence factors , Natural and Artificial transformation

Conjugation: F+ X F- mating, Hfr, Hfr X F-, and F', mechanism of conjugation .

Unit IV: Phage genetics **No. of Hours: 10**

Bacteriophage: Life cycle of lytic phage (T4) and lysogenic phage (phage ƛ), Transduction (Mechanism of generalized and specialized transduction, LFT and HFT lysate)

Unit V: Transposable Elements **No. of Hours: 10**

Transposition and its mechanism, Insertion Sequences, Replicative and Non Replicative Transposons, Composite and Non composite transposons, Mu transposons, Uses of transposons

Text Books:

1. Weaver, R. F. (2012). *Molecular biology*. New York: McGraw-Hill. ISBN 0072345179.
2. P.S.VermaandV.K.Agarwal(2008).*Cellbiology,Genetics,MolecularBiology,Evolution and Ecology*. S. Chand & Company Ltd ISBN: 81-219-2442-1.
3. H Lodish*et* al, (2016). *Molecular Cell Biology*. 8/e, Freeman, ISBN 9781464183393.
4. Stanley R. Maloy, John E. Cronan, David Frielfeder. Mivrobial Genetics. Naraso Publishing House.
5. R.C. Dubey and D.K. Maheshwari. Textbook of Microbiology. S.Chand& Co. Ltd.

Reference Books:

5. GMCooper&REHausman.(2016).*TheCell MolecularApproach*.7/e.ISBN978-1-60535-290-9.
6. JDWatson.(2013).*MolecularBiologyoftheGene*,7/e.Pearson.ISBN978-0321762436.
7. Benjamin Lewin, *Genes IX*. (2008). Publisher: J&B ISBN:0763752223

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Memorize the terms, discoveries and methods used in genetics.
CO2	Discuss genes, mutation, transposition and gene exchange in bacteria.
CO3	Identify different types of plasmids and bacteriophages and their role in transformation, conjugation and transduction
CO4	Correlate the knowledge of genes with mechanism of mutation and transposition, and plasmids with mechanism of transformation, transduction and conjugation.
CO5	Summarize the events that takes place in life cycles of bacteriophages and appreciate concept of genes and plasmids and gene transfer mechanism
CO6	Write about mechanism of genetic exchange, mutation and transposable elements.

B. Sc.Microbiology

Course code	**:COCCR-206**
Course Name	**ENGLISH COMMUNICATION**
Semester	**: II**

L	T	P	C
2	0	0	0

CourseObjectives:

1.Todefineandexplainvarioustechniquesofwordformationanddevelopskillsowritingand vocabulary building.
2. Toillustrateandelaboratefundamentaltechniquesandfeaturesofwritingskills.
3.Todemonstrateanddiscussvarioustypesofcommonerrorecommittedbyusersof Englishandsolveexercises todeveloptheirunderstanding of grammaticallycorrectsentence.
4. Toorganizelanguageandworkdeveloporalcommunicationskills

Unit 1:Theory of Communication, Types and Modes of Communication: (8 Periods)
Introduction, Definitions and Function of Communication, Needs for Effective Communication, Process of Communication, Barrier to Communication, Kinds of Communication; Intrapersonal, Personal, Group and Mass, Verbal and Non-verbal Communication.

Unit 2:Listening and Speaking Skills: (8 Periods)
Types of Listening, Developing Effective Listening Skills, Academic Listening (Lectures), Listening to Talks and Presentation, Monologue, Dialogue, Group Discussion, Miscommunication, Interview, Public Speech, Pronunciation, Accent and Intonation and Rhythm.

Unit 3: Reading Skills: (8 Periods)
Skimming, Scanning, Summary, Paraphrasing, Comprehension.

Unit 4:Introductory English Grammar: (8 Periods)
Parts of Speech, Tenses, Punctuation, Common Errors in English.
Unit 5: Writing Skills; Social and Official Correspondence: (8 Periods)
Enquiries, Complaints and Replies, Letters to the Editor, Social Appeals in the Form of Letter/ Pamphlets, Standard Business Letter, Email Drafting and Etiquettes, Preparing Agenda and Writing Minutes for Meetings.

Unit 6: Career Skills:(8 Periods)
Job Application, Cover Letter, Bio-data, CV and Resume and Effective Profiling, Mock Interviews, Group Discussions.
SUGGESTED READINGS AND TEXT BOOKS
1. Fluency in English- Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (Forthcoming) ed. Dr. Gauri Mishra, Dr. RanjhanaKaul, Dr. Brati Biswas.

COURSE OUTCOME(CO): Uponsuccessfulcompletionofthiscoursethestudentwill:

1. ApplytheLaboratoryskillstoparticipateinthe carrier ofForensiccommunity.
2. Be able tocometrainedinthelaboratoryskillsofdifferentdivisionofForensicScience.
3. BeabletoworkwithdifferentR&Dorganizations.
4. Learn abouttheknowledgeabouttheimportanceofcybersecurityinforensicsciences.

COURSE OUTCOMES (CO): Oncompletionofthiscoursethestudentswillbeableto:

CO	Description
CO1	Rememberabout different facets of forensics.
CO2	Remember and Understand the concept of forensic science including fingerprinting ,toxicology and fire arm and explosives.
CO3	Explain the concept of forensic science including fingerprinting ,toxicology and fire arm and explosives.
CO4	Explain forensic science laboratory and its organization and branches of forensic science,Concept of fire arms and explosives ,fingerprinting and toxicology and will be able to compare handwritings and analyze ink various samples.
CO5	Summarize fundamental basics of forensic science and fingerprinting
CO6	Develop generalized concept of forensic science.

Diploma Course in Microbiology

B. Sc. Microbiology

Course code	**:MICMC-301**
Course Name	**: MOLECULAR BIOLOGY**
Semester	**: III**

L	T	P	C
4	0	0	4

Unit I: Nucleic acid and Chromosome Structure **No. of Hours: 10**

Experimental evidences for nucleic acid as carrier of genetic information; Chemical properties of genetic material; Structure and types of DNA; Packaging of DNA into chromosome; Structure and functions of mRNA, tRNA and rRNA.

Unit II: Replication and Transcription **No. of Hours: 20**

DNA replication: Meselson and Stahl's experiment, Enzymes involved in DNA replication, Mechanism of replication in prokaryotes and eukaryotes, Rolling circle model of replication; Transcription: Promoter, RNA polymerases, Mechanism of transcription in prokaryotes and eukaryotes, Post transcriptional modifications.

Unit III: Translation **No. of Hours: 10**

Basic features of genetic code; Translation: Structure of ribosomes, Mechanism of translation in prokaryotes and eukaryotes.

Unit IV: Mutation and Repair Mechanism **No. of Hours: 12**

Mutations: Types of mutations, Mutagens; DNA repair: Photoreactivation, Methyl directed mismatch repair, Nucleotide excision repair, Base excision repair, SOS system.

Unit V: Microbial Genetics **No. of Hours: 08**

Transposition: Insertion sequences and transposable elements in prokaryotes and eukaryotes, Mechanism of transposition; Plasmids: Types; Gene transfer mechanisms: Basic idea of transformation, conjugation and transduction.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	DefineNucleicacid,ChromosomeStructure,ReplicationandTranscription,MutationandRepairMechanism Translation, MicrobialGenetics .
CO 2	Generalize the concept of genetic material, enzymes in DNA replication, transcription, translation and concept of mutation and repair mechanism
CO 3	Illustrate diagrammatically Transcription and Translation mechanism in prokaryotes and eukaryotes, mutation and repair mechanism
CO 4	Explain and Differentiate between the types of nucleic acid, role of enzymes involved in replication, transcription and translation in prokaryotes and eukaryotes, types of mutation and DNA repair methods.
CO 5	Summarize the process of replication, transcription, translation, mutation and repair mechanism.
CO6	Develop structure of Nucleic acid and generalize the concept of molecular biology and microbial genetics.

B. Sc. Microbiology

Course code	**: MICML-301**
Course Name	**: MOLECULAR BIOLOGY**
Semester	**: III**

L	T	P	C
0	0	2	2

CourseObjectives:Theobjectivesofthislabcourseare

1. TomakestudentabletoisolateDNAfrombacterialcultureandto visualize by Agarosegel Electrophoresis.
2. TodeterminethequalityofDNAandstudytheeffectofpHandtemperatureonDNA.
3. Tomakeanunderstandingaboutthesemi-conservativereplicationofDNA.

TOTALHOURS:60 **CREDITS:02**

1. IsolationofDNAfrombacterialculture.
2. VisualizationofDNAby Agarose Gel Electrophoresis.
3. Studyofeffectoftemperatureondenaturationof DNA.
4. Studyof effect topHonStudyofdifferenttypesofDNAandRNAusingmicrographsandmodel /schematicrepresentations.
5. StudyofsemiconservativereplicationofDNAthroughmicrographs/schematicrepres entations.
6. DeterminationofqualityofDNA.
7. QuantitativeestimationofDNA.
8. QuantitativeestimationofRNA.
9. IsolationofgenomicdenaturationofDNA.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	State semi-conservativereplicationofDNA throughmicrographs/schematicpresentations VisualizeDNAby Agarose Gel Electrophoresis.
CO 2	Quantitatively estimate DNA and RNA and illustrate the methods of isolation of genomic DNA.
CO 3	Determine quality of DNA
CO 4	Determine the effect of temperature on denaturationofDNA and effectofpHonStudyofdifferenttypesofDNAandRNA.
CO 5	Test of quality of DNA
CO6	Create a competent cell

B. S.c Microbiology

Course code	**:MICMC-302**
Course Name	**:Food Processing and Preservation**
Semester /Year	**: I**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To provide scientific knowledge related to various techniques associated with Food and Beverages Biotechnology.
2. To impart laboratory skills for handling analytical tools in Food and Beverages industry and research institution.
3. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
4. To demonstrate the operating procedures associated with upstream and downstream process related to Food and Beverages.

Couse Contents [Credit - 4]

Unit 1 **No. of Lecture-12**

Food and Microorganism: Microorganism in food & beverage industry, contamination of food. General principles underlying spoilage and chemical changes

Unit 2No. of Lecture-12

Contamination and spoilage of different kinds of food & beverages: Cereals & cereal products, sugar and sugar products, vegetables and fruits, meat, fish, poultry &eggs,sea food, milk & milk products, canned foods, Alcohol & alcoholic beverages fruit juices & soft drinks etc.

Unit 3No. of Lecture-12

Biotechnology of food and feed; cultures &fermentation,Beverage production: Alcohol & alcoholic beverages, fruit furies, soft drinks, feed production, SCP, fats, amino acid, food additives.

Unit 4No. of Lecture-14

Food, Beverages &Disease : Food borne illness due to bacterial food poisoning, infection and intoxication. Food-borne disease outbreaks, Disease-investigation, Materials &Equipments, laboratory testing, field analysis, interpretation of data and preventive measures.

Unit 5No. of Lecture-12

Food hygiene: Food sanitation, Bacteriology of water and food products, food manufacturing practice. Hazard Analysis Critical Points. Processing Industry and Microbial criteria of food. Principles of food preservation: Preservation by high temperature, low temperatures, Drying, Food additives and Radiation.

Suggested Reading and Text Books

1. Food Sciences and Food biotechnology- G.F.G. Lopez, G. Canaas, E.V.Nathan
2. Genetically Modified Foods- M.Ruse, D. Castle (Eds.)
3. Biotechnology of Food Crops in Developing Countries- T.Hohn and K.M. Leisinger (Eds.)
4. Biotechnology and Food Process Engineering- H.G. Schwartzberg, M.A. Rao (Eds.)
5. Food Biotechnology- (Eds.) R.Angold, G.A.Beech, J.Taggart.
6. Food Biotechnology—Microorganisms- (Ed.) Y.H. Hui et al.

Uponsuccessful completion ofthecourseastudentwillbeableto

CO 1	Definefood Microorganism.,food hygienic and sanitization.
CO 2	Generalize the concept of food born illness,food beverage and disease.
CO 3	Illustrate diagrammatically different types of food spoilage.
CO 4	Explain and Differentiate between the types of contamination of food products and its prevention.
CO 5	Summarize the process of food preservation ,storage of food.
CO6	Develop structure of food and Beverages and generalize the concept of Food Microbiology .

B. S.c Microbiology

Course code	**:MICML-302**
Course Name	**:Food Processing and Preservation**
Semester /Year	**: I**

L	T	P	C
0	0	2	2

1. Microbiological examination offood.
2. Assay of quality of milk sample using MBRTtest.
3. Adulteration tests formilk.
4. Microbial production ofcurd.
5. Isolation and identification of *Lactobacillus* from fermented dairyproducts.
6. Isolation and biochemical identification of microorganisms from contaminated food and dairy samples.
7. Production of sauerkraut.
8. Estimation of lactic acid production insauerkraut.
9. Effect of salt concentration on lactic acid production insauerkraut.

Upon successful completion of the course a student will be able to

CO1	Identification of food borne, environmental and soil borne diseases and detection of viral antigens in blood sample.
CO2	Interpretation of aerial photographs and data in GIS
CO3	Assess quality of food, drugs and environmental samples.
CO4	Characterize bacteria isolated from soil, food and environment.
CO5	Evaluate production of lactic acid in sauerkraut.
CO6	Production of Mushroom .

B. Sc. Microbiology

Course code	**: MICME- 303a**
COURSE NAME :	**CHEMISTRY-I**
Semester	**: III**

L	T	P	C
4	0	0	4

Courseobjectives: Thecourseaimstoteachtheprinciplesofchemistry.Thespecificobjectivesof the courseare:

1. Toteachstudentsthebasicconceptsofchemistry.
2. Tomakestudentsunderstandtheimportanceofchemistryinsustainabledevelopment.
3. To teach students the fundamental principles of biocatalysis, photochemistry andelectrochemistry.
4. Toteachstudentsaboutchemistryindailypractice.

UNIT I (18 Periods)

Stereochemistry: Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type. Conformation: Restricted rotation about single bonds, Various conformations of ethane, butane and cyclohexane. Relative stability of different conformations in terms of energy difference is to be discussed for all these compounds. Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism.

UNIT II (10 periods)

Alkenes and Alkynes: Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation (cis and trans),oxymercurationdemercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes.

UNIT III (15 Periods)

Free radical substitution reactions: Halogenation of alkanes, allylic compounds and alkylbenzenes.

Nucleophilic substitution reactions: Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. Mechanism of SN1 and SN2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group).

UNIT IV (17 Periods)

Elimination Reactions: Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination).

Mechanism of E1 and E2 reactions (nature of substrate and base), elimination vs substitution. Oxidation Aromatic side chain: Oxidation with potassium permanganate, potassium dichromate Introduction and reactions of Alcohols, Aldehydes, Ketones and Nitro compounds

SUGGESTED READING AND TEXT BOOKS

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical OrganicChemistry, 5th Ed., Pearson (2012).
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Longman, London & New York.
3. Ahluwalia, V.K.; Dhingra, S. & Gulati, A. College Practical Chemistry, Universities Press.
4. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
5. R. T. Morrison & R. N. Boyd: Organic Chemistry, Pearson Education.
6. Arun Bahl and B. S. Bahl : Advanced Organic Chemistry, S. Chand
7. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
8. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
9. **T. W. Graham Solomon's Organic Chemistry, John Wiley and Sons.**
10. P.S. Kalsi, Stereochemistry, Conformation and Mechanism, John Wiley and Sons.
11. Nasipuri, Stereochemistry of Organic Compounds, New Age International Publishers.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Describe** the different basic concepts ofchemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.
CO2	**Explain** the **specific** concepts of chemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.
CO3	**Explain the** essentialtechniquesandfeatureconcepts of chemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.
CO4	**Focus on the concept of** concepts of chemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.
CO5	Summarize about analyzing, applying, remembering, and understandingthe principle, methods, properties and functions of chemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.
CO6	**Generalize about the** Evaluating, Analyzing, demonstrating, remembering, and understandingthe Take part inessentialtechniquesandfeaturesofchemistry: stereochemistry, alkenes and alkynes, Aldehydes and ketones, Free radical substitution reactions, Nucleophilic substitution reactions, Electrophilic Substitution Reactions, Elimination Reactions and the different functional groups.

B. Sc. Microbiology

Course code	**: MICML-303a**
Course Name	**:Lab Course Based on MICME 303a**
Semester	**: III**

L	T	P	C
0	0	2	2

Practicals

1. Purification of organic compounds by crystallization using the following solvents: (a) Water (b) Alcohol

2. Determination of the melting points of organic compounds (by Kjeldahl method and electrically heated melting point apparatus).

3. Determination of optical- 1g of starting compound. Recrystallize the product and determine the melting point of activity by using polarimeter Organic preparations: Carry out the following preparations using 0.5 the recrystallized sample.

4. To prepare acetanilide by the acetylation of aniline.

5. To prepare p-bromoacetanilide.

6. Benzolyation of aniline or β-naphthol by Schotten-Baumann reaction

7. Hydrolysis of benzamide or ethyl bezoate.

8. Semicarbazone derivative of one the following compounds: acetone, ethyl methylketone, diethylketone, cyclohexanone, benzaldehyde.

9. Nitration of nitrobenzene.

10. Oxidation of benzaldehyde by using alkaline potassium permanganate.

CO	Description
CO1	Identify and describe the concept of Chemistry and analysis of chemical compounds..
CO2	Explain thespecific and basicconcepts of chemistry, sustainabledevelopment, Biocatalysis, Photochemistry,electrochemistryandfuelcells**.**
CO3	.Determine and write about the concepts of Chemistry,sustainabledevelopment,biocatalyst,Photochemistry,electrochemistry and fuel cells.
CO4	Focus on the concept of chemistry and its principles, sustainability parameters ,biocatalyst and Impact of green process technology on the chemical industry.
CO5	.SummarizeaboutChemistry, sustainabledevelopment,biocatalyst,Photochemistry,electrochemistry and fuel cells.
CO6	Generalize the basics of chemistryand its principles, sustainability parameters ,biocatalyst and Impact of green process technology on the chemical industry.

B. Sc. Microbiology

Course code	**: MICME 303b**
Course Name	**:Green Chemistry**
Semester	**: III**

L	T	P	C
4	0	0	4

Courseobjectives: Thecourseaimstoteachtheprinciplesofgreenchemistry.Thespecificobjectivesof the courseare:

1. Toteachstudentsthebasicconcepts ofgreenchemistry.
2. Tomakestudentsunderstandtheimportanceofgreenchemistryinsustainabledevelopment.
3. To teach students the fundamental principles of biocatalysis, photochemistry andelectrochemistry.
4. Toteachstudentsaboutgreenchemistryindailypractice.

UNITI:Introductionandprinciples [12Hours]
Introductiontogreenchemistryanditsguidingprinciples;greenchemistryandindustry;wasteminimizati on and atom economy; reduction of material use, reduction of energy requirement; energyefficiencyimprovements; alternativeenergy sources; alternativesolvents.

UNITII:Greenchemistryandsustainabledevelopment [12Hours]
The concept of sustainability; green chemistry and sustainability's parameters; sustainable use ofchemical feedstock; sustainable use of water; sustainable use of energy; environmental resilience;life-cycleassessment: Identificationof moresustainableproductsand processes.

UNITIII:Biocatalysis [10 Hours]
Introduction to biocatalysis; chemical production by biocatalysis: bulk chemicals, pharmaceuticals,flavor and fragrance compounds, carbohydrates, enantiomerically pure synthons, polymers;greenbiocatalyticprocesses:biocatalysisinsupercriticalCO_2,biocatalysisinwastetreatment, biodesulfurisation.

UNITIV:Photochemistry,electrochemistryandfuelcells [14Hours]
Impact of green process technology on the chemical industry; heterogeneous catalysis in practice;homogeneouscatalysisinpractice;renewableaschemicalfeedstockandbiocatalysisuseofrene wablefeedstockfortheproductionofchemicals; bioproductionofchemicals inindustry.
Photons as clean reagents; reduced usage of reagents; photochemical reactors; introduction to greenelectrochemistry; electrochemical cells; electrochemical waste minimization; recovery and recyclingofmetal ions; fuel cellelectrochemistry;fuel cell applications.

SUGGESTED READIND AND TEXTBOOKS

1. Clark,JandMacquarrie,D2002.HandbookofGreenChemistryandTechnology,1st ed.BlackwellSci enceLtd.
2. Lancaster,M2010.GreenChemistry:AnIntroductoryText,1st ed.RoyalSocietyofChemistry.
3. Sharma,SKandMudhoo,A2010.GreenChemistryforEnvironmentalSustainability,1st ed.CRCPre

ss, BocaRaton.
4. Torok,BandDransfield,T2017.GreenChemistry:AnInclusiveApproach,1st ed.Elsevier.

CO	Description
CO1	Identify and describe the concept of Green Chemistry,Green chemistry and susainaibility,biocatalyst,biochemistry,electrochemistry and fuel cells.
CO2	Explain thespecific and basicconcepts of green chemistry, sustainabledevelopment, Biocatalysis, Photochemistry,electrochemistryandfuelcells**.**
CO3	.Determine and write about the concepts of Green Chemistry,sustainabledevelopment,biocatalyst,Photochemistry,electrochemistry and fuel cells.
CO4	Focus on the concept of Green chemistry and its principles, sustainability parameters ,biocatalyst and Impact of green process technology on the chemical industry.
CO5	Summarize about Green Chemistry, sustainabledevelopment,biocatalyst,Photochemistry,electrochemistry and fuel cells.
CO6	Generalize the basics of Green chemistryand its principles, sustainability parameters ,biocatalyst and Impact of green process technology on the chemical industry.

B. Sc. Microbiology

Course code	**: MICML303b**
Course Name	**:Lab Course Based on MICME303b**
Semester	**: III**

L	T	P	C
0	0	2	2

Practicals

1 −Prevent Waste
2−Maximize Incorporation of Materials; Atom Economy
3–Use and Generate LessToxic Materials; Less Hazardous Chemical Syntheses
4 –Design Safer Chemicals
5–Safer Solvents and Auxiliaries
6–Minimize energy use; Design for Energy Efficiency
7–Renewable Feedstocks
8–Reduce Derivatives
9– Use catalysts
10– Real-Time Monitoring to Prevent Pollution

Upon successful completion of the course a student will be able to

CO1	Define Basic Aspects of maximize incorporation of material , Introduction to chemistry ,use of generate less toxic materials.
CO2	Summarize basic structure and function of real time monitoring to prevent pollution.
CO3	Write about prevent waste,aromeconomy,design safer chemicals.
CO4	Explain the basic concept of renewable feedstocks and catalysts use .
CO5	Summarize the concept of Real-Time Monitoring to Prevent Pollution .
CO6	Compile and write about the study of photochemistry.

B. Sc. MICROBIOLOGY

Course code	**: MICOE-304**
Course Name	**:VERMITECHNOLOGY-I**
Semester	**: III**

L	T	P	C
2	0	0	2

Courseobjectives: Thecourseaimtoteachtheprinciplesofgreenchemistry.Thespecificobjectivesof the courseare:

1.Toteachstudents aware the properties of earthworms.

2.Tomakestudentsunderstandtheimportanceof Vermitechnology.

3.To teach students the fundamental principles of vermitechnology in Agricultural sectors.

No. of Lecture-15

UNIT-I Introduction to vermiculture. definition, meaning, history, economic important, their value in maintenance of soil structure, role as four r's of recycling reduce, reuse, recycle, restore.

No. of Lecture-15

UNIT-II Key to identify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** the different basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.

CO2	**Explain and Understand**identify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.
CO3	**llustrate the** identify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works..
CO4	**Explain** . basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.
CO5	**Summarize** basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.
CO6	**Create** basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.

B. Sc. Microbiology

Course code	**: MICVC-305**
Course Name	**:: Computational Biology & Bio-informatics**
Semester	**: III**

L	T	P	C
3	0	0	3

UNIT-1 Introduction to Genomics - information flow in biology, DNA sequence data, Experimental approach to genome sequence data, genome information resources. (8 Periods)

UNIT-II. Functional Proteomics - protein sequence and structural data, protein information resources and secondary data bases. (8 Periods)

UNIT-III Computational Genomics - Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format. (8 Periods)

UNIT IV Sequence alignment & data base search - Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment,

DATA base searching using BLAST and FASTA. (10 Periods)

UNIT-V Structural data bases - Small molecules data bases, protein information resources, protein data ban

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** the different basic concepts of introduction to general character and concepts of biostatistics, Biomaths and computer applications: Relation of Life Science with mathematics, Types of Data, Measures biostatical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences. Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units).
CO2	**Explain and Understand** and rememberthespecific and basicconcepts of measurement of biostatistics, Types of Data, Measures biostatical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences. Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units).
CO3	**llustrate the** thedetailedprocessesandfeaturesof biostatical analysis, Types of Data, Measures biostatical analysis, Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units), Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences.
CO4	**Explain** andunderstandingthedetailedstudy related to measurement of biostatical analysis, Types of Data, Measures biostatical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences.
CO5	**Summarize** the measurement of biostatical analysis, Types of Data, Measures biostatical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences.
CO6	**Create** the take part in biostatical analysis, Types of Data, Measures biostatical analysis, Probability classical & axiomatic definition of probability, distributions, sampling, analysis of variance, Correlation and Regression. Emphasis on examples from Biological Sciences. Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units).

B. Sc. Microbiology

Course code	**:COCCR-306**
Course Name	**:Molecular Diagnostics**
Semester	**: III**

L	T	P	C
4	0	0	4

Courseobjectives: Thecourseisdesignedtogiveanoverviewandapplicationsofdifferentmolecularbiology techniqueusedindiseasediagnosis.Thespecificobjectivesofthecourseare:

1. Toteachstudentsdifferentmoleculartechniquesusedfordiseasediagnosis.
2. Tomakestudentsunderstandtheutilizationofthesetechniquesindiseasediagnosis.
3. Toteachtheuseof differentenzymeimmunoassaybaseddiagnosticmethods.
4. Toimparttheknowledgeaboutthemoleculardiagnosticofdifferenthumandiseases.

UNIT I (15 Periods)

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays.Enzyme immunoassays after immuno blotting.Enzyme immuno histochemical techniques.Use of polyclonalor monoclonal antibodies in enzymes immunoassays.Applications of enzyme immunoassays in diagnostic microbiology.

UNIT II (15 Periods)

Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

UNIT III (18 Periods)

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests.Immuno florescence.Radioimmunoassay.

UNIT IV (12 Periods)

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.Transgenic animals.

SUGGESTED READING AND TEXT BOOKS

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. **Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's**Medical
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). M**ims' Medical Microbiology.** 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.
8. **Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's**

Microbiology.7th edition.McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** the different moleculartechniquesusedfordiseasediagnosis, Automation in microbial diagnosis,Molecular methods in clinical microbiology, enzymeimmunoassaybaseddiagnosticmethods GLC, HPLC, Electron microscopy, .flowcytometry and cell sorting.Transgenic animals,
CO2	**Explain** thespecific Molecular methods in clinical microbiology, enzyme immune assaybaseddiagnosticmethods,Transgenic animals and Electron microscopy, .flowcytometry.
CO3	**llustrate the** different moleculartechniquesusedfordiseasediagnosis, Automation in microbial diagnosis,Molecular methods in clinical microbiology, enzymeimmunoassaybaseddiagnosticmethods GLC, HPLC.
CO4	**Explain** .molecular method and Epitope designand applications. Immunodiagnostic tests.Immuno florescence.Radioimmunoassay.
CO5	**Summarize** the moleculartechniquesusedfordiseasediagnosis, Automation in microbial diagnosis,Molecular methods in clinical microbiology, enzymeimmunoassaybaseddiagnosticmethods GLC, HPLC.
CO6	**Create** the Molecular methods in clinical microbiology, enzymeimmunoassaybaseddiagnosticmethods,Transgenic animals and Electron

B. Sc. Microbiology

Course code	**: MICMC-401**
Course Name	**:**Industrial Microbiology
Semester	**: IV**

L	T	P	C
4	0	0	4

UNIT-I Introduction to Industrial microbiology

Brief history and developments in industrial microbiology, Design of fermenters, Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor.

UNIT-IIIsolation of Industrial Strains and Fermentation Medium

Primary and secondary screening, Preservation and maintenance of industrial strains, Ingredients used in fermentation medium - molasses, corn steep liquor, whey and Yeast extract **.**

UNIT-III Microbial fermentation processes

Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin. Industrial production and uses of the enzymes - amylases, proteases, lipases and cellulases

UNIT-IV Modern trends in microbial production

Modern trends in microbial production of bioplastics, bioinsectices (thuricide), biopolymer, Biofertilizers.

Food Fermentation

UNIT -V An introduction to food fermentation, factors affecting, fermentation in food, production of cheese, curd, yogurt, wine and beer, Kefir koumiss.

SUGGESTED READINGS

1. Hershnergev, C.L., Queener, S.W. and Hedemen, Q. Genetics and biotechnology of industrial microorganisms. ASM Press, Washington, D.C.
2. Crueger, W. and Crueger, A. Biotechnology: A textbook of industrial microbiology. Sinauer Associates, Sunderland.
3. Reed, G. Prescott and Dunn's industrial microbiology. Globe Bookservices, London.
4. Demain, A.L and Davies, J.E. Manual of industrial microbiology and biotechnology. ASM Press, Washington, D.C.
5. Casida, J.E. Industrial microbiology. Wiley Eastern, New Delhi.
6. Patel, A.H. Industrial microbiology. MacMillan India Limited, New Delhi.
7. Stanbury, A.H., Whittaker, A. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.
8. Richard, H., George, B., Hagemann, D. and Paul, L. Industrial microorganisms: Basic and applied molecular genetics. ASM Press, Washington, D.C.

Upon successful completion of the course a student will be able to

CO1	Define Basic Aspects of Fermentation , Introduction to Industrial Microbiology,Antibiotic production and Quality Assurance and Validation
CO2	Summarize basic structure and function of fermenter,fermentation,strain improvement and QA and QC
CO3	Write about fermentation, concept of strain improvement, antibiotic production and Guidelines for QA and QC (GMP)and (GLP)inpharmaceutical industry.
CO4	Explain the basic concept of fermenter , Strategiesforstrainimprovement:Production of antibiotic and Quality Assurance and Validation.
CO5	Summarize the concept of Industrial and Pharmaceutical Microbiology.
CO6	Compile and write about the study of Industrial and Pharmaceutical Microbiology.

B. Sc. Microbiology

Course code	**: MICML-401**
Course Name	**:Industrial Microbiology (Lab Course Based on MICMC-401)**
Semester	**: IV**

L	T	P	C
0	0	2	2

1. Isolation and screening of bacterial and fungal cultures for enzymeproduction.

2. Estimation of enzyme production by microbial culture *via* liquid statefermentation.

3. Estimation of enzyme production by microbial culture *via* solid statefermentation.

4. Mediaformulationforenhancedenzymeproductionbymicrobialculture*via* liquid and solidstate fermentation.

5. Optimizationofcultureconditionsforenhancedenzymeproductionbymicrobialculture *via* liquid and solid statefermentation.

6. Production of wine from fruitjuice.

7. Monitoring of sugar reduction during wineproduction.

8. Estimation of alcohol concentration inwine.

9. Estimation of vicinal diketone inbeer.

10. Improvement of strain for increased yield by U.V.mutagenesis.

CO1	Identify and Memorizethe Biosafety guidelines and biosafetylevels.
CO2	Production, monitoring, Estimation of wine.
CO3	Determination the Isolation, biochemicalcharacterization and antimicrobial susceptibility of pathogenic bacteria/fungi /clinical specimens.
CO4	Perform an experiment to determine MIC and MBC concentration of antibiotics by broth dilutiontest.
CO5	Estimate enzyme productionby bacterial and fungal cultures.
CO6	Formulation of media for enzyme production by microbial cultures.

B. Sc. Microbiology

Course code	**: MICMC-402**
Course Name	**:FOOD &DAIRY MICROBIOLOGY**
Semester	**: IV**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. **To aware the studentprinciples of food preservation.**
2. **To make student to aware spoilage of fermented foods**
3. **To aware the student Food Safety and Quality Assurance**

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

Unit I: Food as a substrate for microbial growth **12hrs**

Microbial growth in food- Intrinsic and extrinsic factors, Microorganisms important in food industry: Molds yeast, Bacteria-General characteristics, classification and importance.

Unit II: Food Preservation 12 hrs

Principles of food Preservation, Methods of food preservation-Physical methods-asepsis, high temperature, low temperature, drying, Smoking. Chemical methods (chemical preservatives and food additives), canning.

Unit III: Food borne diseases 10hrs

Infection and Intoxication of *Clostridium, Escherichia, Staphylococcus and salmonella*

UNIT IV: Contamination and spoilage of foods 14 hrs

Contamination of food from green plants and fruits/animal/sewage/soil/water/air/during handling and processing. Causes of spoilage in food.
Characterization of contamination and spoilage of cereals, vegetables, fruits, milk and meat. Spoilageof canned foods.

Unit V: Dairy Microbiology 12hrs
Normal flora of milk and milk products, Fermented milk products: Acidophilus milk, yoghurt, cheese and determination of quality of milk by MBRT and Resazurin test. Probiotics-definition, examples and benefits.

References

1.Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier, W.C. and Westhoff, D.C. Food microbiology.Tata McGraw Hill, New Delhi.
3. Stanbuty, P.F. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.
4. Banwart, G.J. Basic food microbiology.CBS Publishers and Distributors, New Delhi.
5. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.
6. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.

Courseoutcomes:

Uponsuccessfulcompletionofthecourseastudentwillbeableto:

CO1	Define microorganisms in food, factors affecting growth of microbes in food, Principles of Food Preservation**,** canning, Contamination and Spoilage, Foodborne Infections and Intoxications, Dairy microbiology and probiotics.
CO2	Describe microorganisms in food, factors affecting growth of microbes in food, principles and methods of Food Preservation, canning. Factors influencing microbial growth, Characterization of contamination and spoilage of different food products, Explain and differentiate between infection and intoxication and dairy microbiology and probiotics.
CO3	Write about microorganisms in food, factors affecting growth of microbes in food, Principles of Food Preservation**,** canning, Contamination and Spoilage, Foodborne Infections and Intoxications, dairy microbiology and probiotics.
CO4	Explain the detailed understanding about microorganisms in food, factors affecting growth of microbes in food, Principles of Food Preservation**,** canning, Contamination and Spoilage, Foodborne Infections and Intoxications, dairy microbiology and probiotics.
CO5	Summarize the concept of food and dairy microbiology
CO6	Compile and write about the study of food and dairy microbiology.

Text Books:

1. Adams,M.R.,andMoss,M.O.Foodmicrobiology.RoyalSocietyofChemistryPublication,Cambridge
2. Frazier, W.C. and Westhoff, D.C. Food microbiology. Tata McGraw Hill, New Delhi.
3. Stanbuty,P.F.andHall,S.J.Principlesoffermentationtechnology.PergamonPress,Oxford.

Reference Books

1. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.
2. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.
3. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.
4. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London
5. .Ayres,J.C.,Mundt,O.andSandinee,W.E.Microbiologyoffoods.W.H.FreemanandCompany , New

B Sc. Microbiology.

Course code	**: MICML-402**
Course Name	**:FOOD & DAIRY MICROBIOLOGY**
Semester	**: III**

L	T	P	C
0	0	2	2

Microbiological examination offood.

1. Assay of quality of milk sample using MBRTtest.
2. Adulteration tests formilk.
3. Microbial production ofcurd.
4. Isolation and identification of *Lactobacillus* from fermented dairyproducts.
5. Isolation and biochemical identification of microorganisms from contaminated food and dairy samples.
6. Production of sauerkraut.
7. Estimation of lactic acid production insauerkraut.
8. Effect of salt concentration on lactic acid production insauerkraut.

CO1	Define Principles of Food Preservation**,**
CO2	Describe principles and methods of Food Preservation and production in sauerkraut.
CO3	Write about Principles of Food Preservation **technique.**
CO4	Explain and demonstrate of Microbiological examination of food .
CO5	Summarize the concept of food and dairy microbiology
CO6	Compile and write about the study of food and dairy microbiology.

B Sc. Microbiology.

Course code	**: MICME-403a**
Course Name	**:Plant Biotechnology**
Semester	**: IV**

L	T	P	C
4	0	0	4

Course objectives: This course presents an overview of the techniques and underlying theory of plant tissue culture, and plant genetic engineering, and their applications. The specific objectives of thecourseareas follows:

1. Toenablestudentsacquireknowledgeofthefundamentalprinciplesofplanttissueculture.
2. Tolearnaboutdifferentkindsofplantculturetechniques.
3. TomakestudentsunderstandtheprinciplesofAgrobacteriumtumefaciensbiologyandTi-plasmid.
4. To impart knowledge about the diverse applications of plant biotechnology and genetically-modifiedcrops.

UNIT I (15 Periods)

Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II (20 Periods)

In vitro haploid production: Androgenic methods: Anther culture, Microspore culture andogenesis

Significance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic

haploids, factors effecting gynogenesis, chromosome elimination

techniques for production of haploids in cereals.

UNIT – III (15 Periods)

Protoplast Isolation and fusion: Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation Nomenclautre, methods, applications basis and disadvantages.

UNIT – IV (10 Periods)

Plant Growth Promoting bacteria.Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

SUGGESTED READING AND TEXT BOOKS

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.

6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** the different basic concepts of introduction to general character of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria.
CO2	Explain thespecific and basicconceptsofplant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.
CO3	**Illustrate** the detailed processesandfeatures of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.
CO4	**Explain** thedetailedstudy related to plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.
CO5	**Summarize** plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.
CO6	**Generalize** plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.

B. Sc. Microbiology

Course code	**: : MICML-403a**
Course Name	**:Lab Course Based on MICMC-403a**
Semester	**: V**

L	T	P	C
0	0	2	2

Practicals

1. Sterilizationofglassware,plasticwareandpreparationofstocksolutions.
2. PreparationofMurashigeandSkoog(MS)medium.
3. Sterilizationand inoculation ofthe ex- plantonMSmedium.
4. Inductionofcallusfromtheexplant.
5. IsolationofDNA fromplanttissuebyCTABmethod.
6. IsolationofRNAfromplanttissue.
7. Isolationofproteinfromplanttissue.
8. Isolationofprotoplastsbymechanicalmethod.
9. Performseedviabilitytestbytetrazoliumchloridetest.
10. Isolationofplantembryosandtheir*invitro*culture.

CO1	Define and identify the protien from sample
CO2	Explain and learn the preparation of MS Media.
CO3	Illustrate the Sterilizationandinoculationoftheexplanton MSmedium.
CO4	Explain plant tissue culture technique.
CO5	Summarize the concept of seedviabilitytestbytetrazoliumchlorides.
CO6	Create theory of plant tissue culture, and plant genetic engineering, and their applications

B. Sc. Microbiology

Course code	**: MICME-403b**
Course Name	**:Chemistry- II**
Semester	**: IV**

L	T	P	C
4	0	0	4

Course objective: This course is aimed to introduce the knowledge of biomolecules and their role inmetabolicpathways. Also, itdeals with thestructureand function ofenzymes.

UNIT I (10 Periods)

Carbohydrates: Classification of carbohydrates, reducing and non-reducing sugars, General properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers.Determination of configuration of glucose (Fischer proof).Cyclic structure of glucose.Haworth projections.Cyclic structure of fructose.

UNIT II (12 Periods)

Amino Acids, Peptides and Proteins: Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins.

UNIT III (20 Periods)

Enzymes and correlation with drug action: Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (competitive and noncompetitive inhibition including allosteric inhibition).

UNIT IV (18 Periods)

Components of Nucleic acids: Adenine, guanine, thymine and cytosine (structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

SUGGESTED READING

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson

4. **Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H.** Freeman.
5. Berg, J. M., Tymoczko, J. L. &Stryer, L. Biochemistry 7th Ed., W. H. Freeman.
6. **Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's** Textbook of Practical Organic Chemistry, ELBS.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the different basic concepts of introduction to Carbohydrates, amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Enzyme inhibitors and their importance.
CO2	**Explain** thespecific and basicconcepts ofCarbohydrates, amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Biological roles of DNA and RNA: Replication, Transcription and Translation.
CO3	Illustrate the processes, essentialtechniquesandfeatures ofCarbohydrates, amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Biological roles of DNA and RNA: Replication, Transcription and Translation.
CO4	**Focus on the** concepts of Carbohydrates, amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Biological roles of DNA and RNA: Replication, Transcription and Translation. Enzyme inhibitors and their importance.
CO5	**Summarize the** principle, methods, properties and functions of Carbohydrates, amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Biological roles of DNA and RNA: Replication, Transcription and Translation. Enzyme inhibitors and their importance.
CO6	**Create** amino acids, peptides, proteins, Enzymes and correlation with drug action and Components of nucleic acids. Biological roles of DNA and RNA: Replication, Transcription and Translation. Enzyme inhibitors and their importance.

B. Sc. Microbiology

Course code	**: MICML 403b**
Course Name	**: Lab Course Based on MICME403a**
Semester	**: IV**

L	T	P	C
0	0	2	2

Practicals

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/nonreducing sugar.
9. Extraction of DNA from onion/ cauliflower
10. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the different type of chromatography.
CO2	**Explain** thespecificsaponification value in fat..
CO3	Illustrate the reducing and nonreducing sugar.
CO4	**Focus on the** concepts of Genomic DNA of different sampleand also study the Agarose gel electrophoresis..
CO5	**Summarize the** principle, methods, properties and functions of chromatography.

B. Sc. Microbiology

Course code	**: MICOE-404**
Course Name	**:VERMITECHNOLOGY-2**
Semester	**: IV**

L	T	P	C
2	0	0	2

COURSE OBJECTIVE-

Courseobjectives: Thecourseaimstoteachtheprinciplesofgreenchemistry.Thespecificobjectivesof the courseare:

1.Toteachstudents aware the properties of earthworms.

2.TomakestudentsunderstandtheimportanceofVermitechnology.

3.Toteach students the fundamental principles ofvermitechnologyin Agricultural sectors.

COURSE-

UNIT-I No. of Lectures-15

Biology of Eisenia fetida. a) Taxonomy Anatomy, physiology and reproduction of Lumbricidae. b) Vital cycle of Eisenia fetida: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).

UNIT-IINo. of Lectures-15

Biology of Eudriluseugeniae. c) Taxonomy Anatomy, physiology and reproduction of Eudrilidae. d) Vital cycle of Eudriluseugeniae: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** the different basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.
CO2	**Explain and Understand** Biology of Eisenia fetida. a) Taxonomy Anatomy, physiology and reproduction of Lumbricidae. b) Vital cycle of Eisenia fetida: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).
CO3	**llustrate the** identify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.

CO4	**Explain** .Biology of Eisenia fetida. a) Taxonomy Anatomy, physiology and reproduction of Lumbricidae. b) Vital cycle of Eisenia fetida: alimentation, fecundity, annual reproducer potential and limit factors (gases, diet, humidity, temperature, PH, light, and climatic factors).
CO5	**Summarize** basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.
CO6	**Create** basic concepts of introduction to vermitechnologyidentify the species of earthworms His role in bio transformation of the residues generated by human activity and production of organic fertilizers. How does nature works.

B. Sc. Microbiology

Course code	**: MICVC-405**
Course Name	**:**Food fermentation Technique
Semester	**: IV**

L	T	P	C
3	0	0	3

No. of Lecture- 12

Unit I: Fermented Foods No. of Hours: 05 Definition, types, advantages and health benefits of fermented foods; Probiotics.

Unit II: Milk Based Fermented Foods **No. of Lecture- 12**

Preparation of inoculums, microorganisms and production process: Dahi, Yogurt, Buttermilk, Cheese.

Unit III: Grain Based Fermented FoodsNo. of Lecture- 12

Microorganisms and production process: Soy sauce, Bread, Idli, Dosa.

Unit IV: Vegetable Based Fermented Foods No. of Lecture- 12

Microorganisms and production process: Pickle, Sauerkraut.

Unit V: Fermented Meat and Fish ProductsNo. of Lecture- 12

Microorganisms and production process: Sausages and sauces.

TextBooks:

TB1. Frazier,W.C.andWesthoff,D.C.Foodmicrobiology.TataMcGrawHill,NewDelhi

ReferenceBooks:

RB1. Adams,M.R.,andMoss,M.O. Foodmicrobiology.RoyalSocietyofChemistryPublication,Cambridge.

RB2. Stanbuty,P.F.andHall,S.J.Principlesoffermentationtechnology.Pergamon Press,Oxford.

RB3. Robinson,R.K.Dairymicrobiology.ElsevierAppliedSciences,London

RB4. JamesM.J.Modernfoodmicrobiology.CBSPublishersandDistributors,NewDelhi.

RB5. Wood,B.J.Microbiologyoffermentedfoods.ElsevierAppliedSciences,London .

RB6. Ayres,J.C.,Mundt,O.andSandinee,W.E.Microbiologyoffoods.W.H.Freemanand Company,New York.

RB7. Hui,Y.H.,Meunier-Goddik,L.,Josephsen,J.,Nip,W.K.andStanfield,P.S.Handbookoffoodandfermentationtechnology.CRCPress,BocaRaton.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Define fermented foods and state its importance, recognize milk based, grain based, meat and vegetable based fermented foods
CO 2	Describe types and health benefits of fermented foods, microorganisms involved in fermented foods.
CO 3	Illustrate the methods involved in production of fermented foods.
CO 4	Explain and Differentiate between the milk, grain and meat based fermented foods.
CO 5	Summarize the role of microbes involved in fermentation process and role of probiotics
CO6	Generalize the concept of different food based fermented products

B. Sc. Microbiology

Course code	**:COCCR -406**
Course Name	**:Drug Designing**
Semester	**: IV**

L	T	P	C
2	0	0	0

Courseobjectives: Thecourseisdesignedtogiveanoverviewoftheprocessofdrugdesignandd evelopment.Thespecificobjectives of thecourseareasfollows:

1. Toteachthecriteriausedfordrugdevelopmentasaprocessinvolvingtargetselection andleaddiscovery.
2. Toimparttheknowledgeaboutcomputeraideddrugdesign.
3. Togivestudentsanoverviewofdrugdeliverysystem,preclinicalandclinicaltesting.

UNIT I (15 Periods)

Delivery considerations of biotechnological products: Introduction, Stability profile, Barriers to proteins and peptide delivery, Delivery of protein & peptide drugs, Lymphatic transportation of proteins, Site specific protein modification (protein engineering), Toxicology profile characterization.Drug targeting and drug delivery systems, Introduction to drug design cycle, Introduction to molecular modeling.

UNIT II (15 Periods)

Vaccines: Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.

Suggested Reading and Text Books

1. Hill,RGandRang,HP2012.DrugDiscoveryandDevelopment:TechnologyinTran sition.2nded.Churchill Livingstone.
2. Kenakin,TP2012.PharmacologyinDrugDiscovery,1sted.Elsevier.
3. Gad,SC2005.DrugDiscoveryHandbook,1sted.Wiley-Interscience.
4. Stromgaard,K,Krogsgaard-Larsen,Pand Madsen,U2016.TextbookofDrugDesignandDiscovery,5th ed. CRC press.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Remember** the different basic concepts of introduction to delivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling.
CO2	**Understand** and remember thespecific and basicconcepts ofdelivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling, Docking and modeling substrate and s/w tools for CADD.
CO3	**Applying,** understanding and rememberingthedetailedprocesses, essentialtechniquesandfeaturesofdelivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling, Docking and modeling substrate and s/w tools for CADD.
CO4	**Analyzing,** applying, remembering andunderstandingthedetailedstudy related to concepts of delivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling, Docking and modeling substrate and s/w tools for CADD.
CO5	**Evaluating,** analyzing, applying, remembering, and understandingthe principle, methods, properties and functions of delivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling, Docking and modeling substrate and CADD.
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understandingthe take part delivery considerations of biotechnological products, Drug targeting and drug delivery systems,vaccines, drug design cycle and molecular modeling, Docking and modeling substrate and CADD.

DEGREE COURSE IN MICROBIOLOGY

B. Sc. Microbiology

Course code	**:MICMC 501**
Course Name	**:Agricultural Microbiology**
Semester	**: V**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To learn about understandthe Physico-chemical characteristics of soil.
2. To gain knowledge about biocontrol Agents for Agriculturally Important Crop Plants
3. To gain knowledge about isolation, purification, mass multiplication of Biofertilizer.

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

No. of Hours- 12

Unit I:Soil Microorganisms: Development and significant contributions in the field of soil microbiology (Beijerinck and Winogradsky), physical and chemical properties of soil, classification of soils, soil profile, soil microflora and soil as a natural habitat for microbes.

No. of Hours- 14

UNIT IIOrganic Matter Decomposition: Soil organic matters and humus. Microbial decomposition of plant and animal residues by microorganisms. Organic matter dynamics in soil: Degradation of cellulose, hemicelluloses and lignin. Factors affecting organic matter decomposition. Soil microbial biomass as an index of soil fertility.

No. of Hours- 12

UNIT IIIRhizosphere and Rhizoplane microorganism: Microorganisms in the rhizosphere, root surfaces and phylloplane; Composition of root exudates; Factors affecting exudation; Rhizosphere effect; Factors affecting microbial community in soil. Mechanism of plant growth promotion. Biofertilizers

No. of Hours- 12

UNIT IVPlant Diseases: Plant diseases Mode of entry of pathogens, disease symptoms, Bacterial diseases: Crown gall, Citrus cancer; Viral diseases, viroidsTMV; Fungal diseases: Late blight of potato , Loose smut of wheat. Control of plant diseases Principles and practices, cultural practices, chemical methods, biological methods and genetic engineering for disease resistant plants. Biopesticides.

No. of Hours- 12

Unit V:Genetic Engineering in Agriculture: Significance of Agrobacterium tumefaciens and viral vectors in development of transgenic plants- brief technique used. Brief discussion of Bt- cotton, release of GMOs

Text Books:

1. Gupta, S.K,Biofertilizers, KedarNath Ram Nath, Meerut.
2. SubbaRao,N.S(1995).SoilmicroorganismsandplantgrowthOxfordandIBHpublishing co. Pvt. Ltd., New Delhi.

Reference Books

1. Kannaiyan, S. (2003).Bioetchnology of biofertilizers, CHIPS, Texas.
2. Rai,M.K.(2005).HandbookofmicrobialbiofertilizersTheHaworthPress,Inc.NewYork.
3. Reddy,S.M.etal.(2002).Bioinoculantsforsustainableagricultureandforestry.ScientificPublishers.
4. Saleem,F.andShakoori,A.R.(2012).DevelopmentofbioinsecticideLapLambertAcademic Publishing GmbH and Company.
5. Aggarwal, S.K. (2005). Advanced environmental biotechnology. APH publication

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe the role and effect of microorganism in agriculture.
CO2	Identify phytopathogens and apply the knowledge of their life cycle in prevention of plant diseases.
CO3	Apply the knowledge of rhizospheric bacteria in development of biofertilizers.
CO4	Summarize the mechanism of biocontrol utilized by biopesticides
CO5	Appreciate the diversity of microorganism and microbial communities inhabiting soil and affecting soil composition and causing plant diseases.
CO6	Compile information on plant microbes interactions like rhizosphere and mycorrhizae and their applications especially the biopesticides, biofertilizers and their production techniques.

B. Sc. Microbiology

Course code	**:MICML 501**
Course Name	**:Agricultural Microbiology(Lab course based onMICMC 501)**
Semester	**: V**

L	T	P	C
0	0	2	2

1.Isolation of Microrganism in soil.

2. Isolation and Identification of PGPR from soil.

3. Isolation and Identification of *Azotobacter sp* from soil.

3. Perform Biochemical test.

4. IMVIC TEST

5. Production of Biofertilizer from Rhizospheric soil.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the different basic concepts of introduction to soil microorganism.
CO2	Explainthe identification of soil Microorganism.
CO3	Illustrate the processes of nitrogen fixation in plants by experimental method.
CO4	Focus on the identification of microorganism present in soil.
CO5	Summarize the production of bioinoculant and its effects on plant.
C06	Create the importance of nitrogen fixing microorganismin Agriculture sector**.**

B. Sc. Microbiology

Course code	**: MICMC- 502**
Course Name	**:Recombinant DNA Technology**
Semester	**: V**

L	T	P	C
4	0	0	4

UNIT I Introduction and Scope of RDT **No. of Hours-12**

History and advent of Recombinant DNA technology; Milestones in Genetic Engineering. Scope and applications of RDT

UNIT II Tools and enzymes used in RDT **No. of Hours-12**

Cloning vector: Plasmids, Phages, cosmids,Yeast cloning vectors, Animal and plant viruses asvectors.BAC, PAC & YAC. Expression Vectors.Nucleic acid modifying enzymes. Restriction endonuclease

UNIT III Gene Cloning and its strategies **No. of Hours-14**

Isolation of nucleic acid from plant, animal & bacteria. Basic steps of gene cloning: Cloning strategies Cutting and joining vectors; use of linkers and adaptorsIntroduction of recombinant DNA in host cell, methods of screening transformants and recombinants.Synthesis of cDNA. Construction of cDNA and genomic libraries.

UNIT IV Techniques in RDT **No. of Hours-12**

Blotting techniques: Southern, Northern andWestern blotting (Methodologies and applications)Probe labeling and hybridization.DNA sequencing: chemical and enzymatic methods.PCR

UNIT V Applications of RDTNo. of Hours-12

Transgenic Technology: Types approaches & application (Plant & Animals)Gene Therapy: Principle, strategies and ethics of gene therapyDNA fingerprintingHuman Genome Project: Strategy and Implications

Text Books:

1. Brown,T.A.GenecloningandDNAanalysis:Anintroduction.Wiley-Blackwell,NewJersey.
2. Primrose,S.B.andTwyman,R.Principlesofgenemanipulationandgenomics.Wiley-Blackwell, NewJersey.
3. Brown, T.A. Genomes. Wiley-Liss, Oxford
4. Sambrook,J.andRussell,D.W.MolecularCloning:Alaboratorymanual.ColdSpringHarbor LabPress, New York.

Reference Books

1. Nicholl, D.S.T. An introduction to genetic engineering. Cambridge University Press,Cambridge.
2. Glick, B.R., Pasternak, J.J. and Patten, C.L. Molecular biotechnology: Principles andapplicationsofrecombinant DNA. ASM Press, Washington, D.C.Hartwell, L. Genetics:From genes to genome. McGraw-Hill, New York.
3. Old,R.W.andPrimrose,S.B.Principlesofgenemanipulations.BlackwellScience,Oxford.
4. Winnacker, E.L. From genes to clones: Introduction to gene technology. Wiley-VCH,Germany.
5. Reece R.J. Analysis of genes and genomes. John Wiley and Sons, New York.
6. Recombinant DNA safety guidelines. Department of Biotechnology, Ministry of ScienceandTechnology, Government of India, New Delhi.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe principles, tools, techniques and strategies used in gene cloning and genome analysis.
CO2	Elucidate the molecular techniques involved in gene manipulation and rDNA technology .
CO3	Explain the concept of vectors and gene transfer methods for the production of transgenic plants and animals.
CO4	Appreciate the techniques used in genome analysis and their applications.

CO5	Summarize the role of vectors in gene cloning and expression.
CO6	Develop understanding of sequence detection, gene amplification, modification and genome analysis techniques and also applications of RDT.

B. Sc. Microbiology

Course code	**: MICML- 501**
Course Name	**:RDT**
Semester	**: V**

L	T	P	C
0	0	2	2

1. Determination of molecular weight ofDNA by Agarose Gel Electrophoresis.
2. Separation and determination of molecular weight of proteins bySDS-PAGE.
3. Visualization of enzyme activity by NATIVE-PAGE.
4. Isolation of genomic DNA from plant sample.
5. Isolation of genomic DNA from animal cell
6. Isolation of plasmid DNA from bacterial cell.
7. Isolation of genomic DNA from bacterial cell
8. PCR amplification of DNA.
9. Restriction digestion of vector and DNA.
10. Preparation of competent cells.
11. Determination of similarity between different bacterial isolates using RFLP.

Course outcomes (Cos):

Upon successful completion of the course a student will be able to

CO1	Identify and separate amino acid and sugars by chromatographic techniques**.**
CO2	Interpret molecular weight of DNA by gel electrophoresis techniques.
CO3	Demonstrate isolation of genomic and plasmid DNA and visualize by electrophoresis

CO4	Verify Lambert Beer's law.
CO5	Perform restriction digestion and amplification of DNA.
CO6	Prepare competent cells.

B. Sc. MICROBIOLOGY

Course code	**:MICME 503a**
Course Name	**:Beverage Biotechnology**
Semester	**: V**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. **To aware the studentMicroorganism in food & beverage industry.**
2. **To make student aware about principles of food preservation**
3. **To learn about food additives.**

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

UNIT I **No of Hours-14**

Food and Microorganism: Microorganism in food & beverage industry, contamination offood. General principles underlying spoilage and chemical changes

UNIT II **No of Hours-08**

Contamination and spoilage of different kinds of food & beverages: Cereals &cerealproducts, sugar and sugar products, vegetables and fruits, meat, fish, poultry & eggs, seafood, milk & milk products, canned foods, Alcohol & alcoholic beverages fruit juices &soft drinks etc.

UNIT III **No of Hours-15**

Biotechnology of food and feed; cultures & fermentation, Beverage production: Alcohol& alcoholic beverages, fruit furies, soft drinks, feed production, SCP, fats, amino acid,food additives.

UNIT IV **No of Hours-10**

Food,Beverages&DiseaseFoodborneillnessduetobacterialfoodpoisoning,infectionandintoxication.Food-bornediseaseoutbreaks,Disease-investigation,Materials &Equipment laboratory testing, field analysis, interpretation of data andpreventive measures.QA &QC of food product.

UNIT V **No of Hours-13**

Foodhygiene:Foodsanitation,Bacteriologyofwaterandfoodproducts,foodmanufacturingpractice. Hazard Analysis Critical Points.
Foodcontrol:Internationalagencies,FederalAgencyandlawofProcessingIndustryandMicrobialcriteriaoffood.PrinciplesoffoodpreservationPreservationbyhightemperature,lowtemperatures,Drying,FoodadditivesandRadiation.

Text Books:

1. Frazier, W.C. and Westhoff, D.C. Food microbiology.Tata McGraw Hill, New Delhi.
2. Casida, J.E. Industrial microbiology.Wiley Eastern, New Delhi.

Reference Books:

1. Crueger,W.andCrueger,A.Biotechnology:Atextbookofindustrialmicrobiology.Sinauer Associates, Sunderland.
2. McLandsborough, L. Food microbiology laboratory. CRC Press, Boca Raton.
3. Harrigan,W.F.Laboratorymethodsinfoodmicrobiology.GulfProfessionalPublishing,Houston.
4. Cappucino,J.andSherman,N.Microbiology:Alaboratorymanual.BenjaminCummings Publishing Company, San Francisco.
5. Frazier, W.C. and Westhoff, D.C. Food microbiology.Tata McGraw Hill, New Delhi.
6. Casida, J.E. Industrial microbiology.Wiley Eastern, New Delhi

Upon successful completion of the course a student will be able to

CO1	Identifyand describe theMicroorganism in food & beverage industry, contamination and spoilage of different kinds of food and beverages, Biotechnology of food and feed, Food,Beverages&Disease and food hygiene.
CO2	Discuss about microorganisms, contamination and spoilage of food and beverage industry, Biotechnology of food and feed, Bacterial food borne infection and intoxication, disease outbreak ,disease analysis and food hygiene and food control agencies.
CO3	Explain Microorganism in food & beverage industry, contamination and spoilage of different kinds of food and beverages, Biotechnology of food and feed, Food,Beverages&Disease and food hygiene
CO4	Explain and compare the role of Microorganisms in food & beverage industry, contamination and spoilage, Bacterial food borne infection and intoxication and explain disease outbreak, disease analysis and food hygiene and food control agencies.
CO5	Summarize the Microorganisms, contamination and spoilage in food & beverage industry, Bacterial food borne infection and intoxication, disease outbreak, disease analysis and food hygiene and food control agencies
CO6	Generalize the concept of beverage biotechnology.

B. Sc. MICROBIOLOGY

Course code	**:**MICML 503a
Course Name	**:**Beverage Biotechnology (Lab course based on MICML 503a)
Semester	**: V**

L	T	P	C
0	0	2	2

1. Microbiological examination offood.
2. Assay of quality of milk sample using MBRTtest.
3. Adulteration tests formilk.
4. Microbial production ofcurd.
5. Isolation and identification of *Lactobacillus* from fermented dairyproducts.
6. Isolation and biochemical identification of microorganisms from contaminated food and dairy samples.
7. Production of sauerkraut.
8. Estimation of lactic acid production insauerkraut.
9. Effect of salt concentration on lactic acid production insauerkraut.

Upon successful completion of the course a student will be able to

CO1	Define Principles of Food Preservation**,**
CO2	Describe principles and methods of Food Preservation and production in sauerkraut.
CO3	Write about Principles of Food Preservation **technique.**
CO4	Explain and demonstrate of Microbiological examination of food .
CO5	Summarize the concept of food and dairy microbiology
CO6	Compile and write about the study of food and dairy microbiology.

B. Sc. Microbiology

Course code	**: MICME-503b**
Course Name	**:Animal Biotechnology**
Semester	**: V**

L	T	P	C
4	0	0	4

Courseobjectives: Thecourseaimstomakestudentsgainknowledgeinthecurrenttrendsandtechniquesinanimalbiotechnology.Thespecificobjectivesofthecourseareas follows:

1. Todevelopanunderstandingaboutanimalcellcultureandgenedeliverymethodsinanimals.
2. To provideanoverview in-vitrofertilization,embryotransfermethodsandotherrelatedtechniques.
3. Togainknowledgeaboutthestemcellsandtheir variousapplications
4. Tolearnabouttheproductionoftransgenicanimalandgenetherapyandtheirapplications.

UNIT I (10 Periods)

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer,

Retrovirus & Gene transfer.

UNIT II (10 Periods)

Introduction to transgenesis.Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect.

Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis,

Trypanosomiasis, Theileriosis.

UNIT III (20 Periods)

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo

transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV (20 Periods)

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

SUGGESTED READING AND TEXT BOOKS

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.

5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define a gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.
CO2	**Explain** basicconcepts ofanimal biotechnology, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine..
CO3	**Illustrate** thedetailedprocesses, essentialtechniques for identification andfeaturesofanimal biotechnology, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.
CO4	**Explain** thedetailedstudy related to animal biotechnology, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.
CO5	**Summarize the** animal biotechnology, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.
CO6	**Create**, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.

B. Sc. Microbiology

Course code	**: MICML-503b**
Course Name	**:Lab Course Based on MICMC 503b**
Semester	**: V**

L	T	P	C
0	0	2	2

Practicals

1. Sources of contamination and decontamination measures.
2. Preparation of Hanks Balanced salt solution.
3. Preparation of Minimal Essential Growth medium.
4. Isolation of lymphocytes for culturing.
5. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization.
6. Preparationofanimalcellculturemedia.
7. Inoculationofcellsinanimalcellculturemedia.
8. Trypsinizingandsubculturingcellsfromamonolayer.
9. Performanimalcellcounting.
10. Determinethepercentageofviablecellsbytrypanblueexclusiontest.

11. DNA isolation from animal tissue.

12. Quantification of isolated DNA.

13. Resolving DNA on Agarose Gel.

CO	Description
CO1	Define Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization .
CO2	**Explain and identify** Preparationofanimalcellculturemedia.
CO3	**Illustrate** thedetailedprocesses, of preparation of animal cell culture media.
CO4	**Explain** thedetailedstudy related to animal biotechnology, gene transfer methods in animals, DNAand RNA structure.
CO5	**Summarize the Molecular tools used in** animal biotechnology, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.
CO6	**Create**, gene transfer methods in animals, transgenesis,animal diseases need help of biotechnology,animal propagation andgenetic modification in medicine.

B. Sc. Microbiology

Course code	**:MICME- 504a**
Course Name	**:Bioprocess Technology**
Semester	**: V**

L	T	P	C
4	0	0	4

Courseobjectives: Thespecificobjective of the courseareasfollows:

1. Toimpartthe knowledge ofcultivationandgrowthkineticsofmicroorganisms.
2. Tomakestudentsunderstandthebasicconceptofsterilizationanddifferentpartsobioreactor.
3. Toteachtheapplicationofbioprocesstechnologyinindustries.
4. Tomakestudentsunderstandaboutthermaldeathkineticsofmicroorganisms.

UNIT I (10 Periods)

Introduction to bioprocess technology.

Basic principle components of fermentation technology.Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II (20 Periods)

Airlift; Cyclone Column; Packed Tower and their application in production processes.

Principles of upstream processing – Media preparation, Inoculation development and sterilization.

UNIT III (15 Periods)

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa.

Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV (15 Periods)

Introduction to downstream processing, product recovery and purification.Effluent treatment.

Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

SUGGESTED READING AND TEXT BOOKS

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

CourseOutcomes(COs): On completion nothiscourse,thestudentswillbe:

CO	Description
CO1	Define the basic concepts of introduction to Introduction to bioprocess technology, Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.
CO2	**Explain** thespecific and basicconcepts ofbioprocess technology, Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.
CO3	**Illustrate de**tailed processes, essentialtechniquesandfeatures ofbioprocess technology, Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.
CO4	**Explain the** concepts of bioprocess technology, Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.
CO5	**Summarize the** principle, methods, properties and functions of bioprocess technology, Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.
CO6	**Create a** Basic principle components of fermentation technology, Principles of upstream processing, oxygen requirement in bioprocess, Bioprocess measurement and Microbial production.

B. Sc. Microbiology

Course code	**:MICME- 504b**
Course Name	**:Human Immunology**
Semester	**: V**

L	T	P	C
4	0	0	4

1. To teach students about the diagnostic significance, Principles of ELISA, RIA,
2. Immunodiffusions etc in clinical approaches and their limitations.
3. To introduce students to the challenges involved in diagnostics & health.
4. To adhere skills regarding the use of all laboratory devices related to immunological tests and kits.

Unit 1 No. of Lecture -12

Overview of the Immune System. Cells and Organs of the Immune System. Antigens. Haptens& Epitopes.

Unit 2No. of Lecture -12

Immunoglobulins: Structure and Function. Major Histocompatibility Complex. Antigen processing and presentation. Structure and functions of BCR & TCR.

Unit 3No. of Lecture -12

Cytokines. Complement System. Cell mediated cytotoxicity: Mechanism of T cell & NK cell mediated lysis. Ab-dependent cell mediated cytotoxicity (ADCC).

Unit 4No. of Lecture -12

Overview of Hypersensititivity and Introduction to Transplantation. Vaccines: Active and Passive Immunization.

Unit 5No. of Lecture -14

Introduction to Monoclonal Antibodies and polyclonal Antibodies. Antigen-Antibody Interactions RIA, ELISA, Western Blotting, Immuno precipitation, Immuno-fluorescence.

Suggested Reading and Text Books

1. Kuby : Immunology (4^{th} ed.)
2. Roitt, Male &Brostof : Immunology (3^{rd} ed).
3. Elgert&Elgert : Immunology
4. Wilson & Walker: Practical Biochemistry (4^{th} ed.)

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Remember** the different basic concepts of introduction to Immunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA.
CO2	**Understand** and rememberthespecific and basicconcepts of Immunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA.
CO3	**Applying,** understanding and rememberingthedetailedprocesses, essentialtechniquesandfeatures of Immunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA.
CO4	**Analyzing,** applying, remembering andunderstandingthedetailedstudy related to concepts of Immunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA. Immunity to different organisms.
CO5	**Evaluating,** analyzing, applying, remembering, and understandingthe principle, methods, properties and functions of Immunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA. Immunity to different organisms.
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understandingthe take part inImmunology, Immune Response, Immuno-globulins or Antibodies, Regulation of immunoglobulin gene expression, Major Histocompatibility complexes, Immunity to infection, Vaccines & Vaccination and immunodiagnostics – RIA, ELISA. Immunity to different organisms.

B. Sc. Microbiology

Course code	**:COCCR-505**
Course Name	**:IntellectualPropertyRights**
Semester	**: V**

L	T	P	C
2	0	0	0

Courseobjectives: The courseaims to explain students about intellectual property rightsand patents.Thespecificobjectives of thecoursearefollows:

1. Tomakestudentsawareof typeofIPRsandtheir utility.
2. Tomakestudentsunderstandtheprocedureof filling patent.
3. Toteachstudentsaboutthebioethicalandbiosafetypracticesrelatedtobiotechnology.
4. Tofamiliarizestudentswithcopyright,trademarks,designsandinformactiontechnologyact.

UNITI:Introductionto IPR [15Hours]

BasicunderstandingofintellectualpropertyrightsutilityofIPRsdifferenttypesofIPRsintroductiontoIndianpatentlawworldtradeorganizationanditsrelatedintellectualpropertyprovisions world organizations: WIPO and TRIPS agreement, international treaties and conventionsonintellectual property.Intellectual/industrial property and its legal protection in research, design and development. Forms ofprotectionofIPRs:Introductiontocopyrightsanditsapplicability;fundamentalconceptsandimportanceoftrademarksandtradesecrets;geographicalindications;designlayoutdesignofintegratedcircuits.

UNITII: Patents **[15 Hours]**

Methods of patenting and general concept of patent; patenting agencies; use of technical informationin patent documents; revocation of patent; patenting of biological material like microorganisms, plantandanimal,patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.Nature of Copyright.Trademarks; registration oftrademarks;rights of holder andassignmentand licensing ofmarks.

SUGGESTED READINGS AND TEXTBOOKS

1. Pandey,NandDharni,K2014.IntellectualPropertyRights,1sted.PHILearningPvt.Ltd.
2. Tomkowicz,R2011.IntellectualPropertyOverlaps:Theory,StrategiesandSolutions,1sted.Routledge.
3. Bouchoux,DE2013.Intellectualproperty:TheLawofTrademarks,Copyrights,PatentsandTradeSecrets, 4th ed. CenageLearning.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define** basic concepts of introduction to IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks.
CO2	**Explain the** basic concepts of IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks. Patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.
CO3	**Illustrate the** processesandfeaturesoft IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks. Patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.
CO4	**Explain the s**tudy related to IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks. Patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.
CO5	**Summarize the** IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks. Patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.
CO6	**Create** IPR, Protection ofIPRs, Patents, Copyright, assignmentand licenceof copyright, trademarks and rights of holder andassignmentand licensing ofmarks. Patentinginbiotechnology,economic, ethicalanddepositoryconsiderations.

B. Sc. Microbiology

Course code	**: MICPE 506**
Course Name	**: Project/Educational Tour ReportI**
Semester	**: V**

L	T	P	C
0	0	0	3

Course Objectives: The objectives of this course are

1. To make the students industry, university and research institute deployable.
2. To provide an opportunity to students to gain practical knowledge.
3. To provide an opportunity to pursue higher education in reputed organization across the globe.

Every student must enroll for project/ under the guidance of faculty member/supervisor from industry/research organizations or submit an educational tour report by the guidance of internal supervisor. Students will have to submit project work and will be evaluated at the end of the semester followed by presentation and viva. The thesis will be evaluated internally by a panel of examiner.

Suggested Readings: NA

Course Outcome:

CO1.	Define and understand the practical training and understand the scope and importance of Biotechnology through exposure.
CO2.	**Explain** rememberthespecific and basicconcepts interpretation and organization of data.
CO3.	**Illustrate the** features of develop thesis writing skills and Project/Educational Tour Report.
CO4.	**Explain the** detailedprocessesandfeatures of develop thesis writing skills and Project/Educational Tour Report.
CO5.	**Summarize the** detailedprocessesandfeatures of develop thesis writing skills and Project/Educational Tour Report.
CO6.	**Create** detailedprocessesandfeatures of develop thesis writing skills and Project/Educational Tour Report.

B. Sc. Microbiology

Course code	**: MICMC-601**
Course Name	**:ENVIRONMENTAL MICROBIOLOGY**
Semester	**: VI**

L	T	P	C
4	0	0	4

UNIT-I Microorganisms and their Habitats

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats. Extreme Habitats: Extremophiles: Microbes thriving at high and low temperatures, pH, high hydrostatic and osmotic pressures, salinity and low nutrient levels. Microbial succession on decomposition of plant organic matter.

UNIT-II Microbial Interactions

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.

UNIT-III Biogeochemical Cycling

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin, Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation; Sulphur cycle: Microbes involved in sulphur cycle

UNIT-IV Waste Management

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill),Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment. Treatment and safety of drinking (potable) water, methods to detect portability of water samples.

UNIT-V Microbial Bioremediation

Ex situ and *in situ* bioremediation, Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, microbial biosurfactants

Text Books:

1. Atlas,R.M.andBartha,R.Microbialecology:Fundamentalsandapplications.Benjamin/Cummings Science Publishing, USA.
2. Evans,G.M.andJohn,J.C.F.Environmentalbiotechnology:Theoryandapplications.John Wiley and Sons, New York.

Reference Books

1. Alexander, M. Microbial ecology. John Wiley and Sons, New York
2. Eldowney, S., and Waites, S. Pollution: Ecology and biotreatment. Longman, Harlow.

3. Baker, K.H. and Herson, D.S. Bioremediation. McGraw- Hill, New York.
4. Marshal, K.C. Advances of microbial ecology. Plenum Press, New York.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define terminology used in Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment.
CO2	Explain and give examples where applicable related to ecosystem, ecosystem organization and microbial community, air borne transmission of microbes, aquatic microbiology, Positive and negative interactions amongst microbial populations, Interactions between microorganisms and plants , Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment.
CO3	Write about the concept of ecosystem, ecosystem organization and microbial community, air borne transmission of microbes, aquatic microbiology, Positive and negative interactions amongst microbial populations, Interactions between microorganisms and plants , Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment
CO4	Explain Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO5	Summarize the study of Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO6	Generalize the concept of Environmental Microbiology

B. Sc. Microbiology

Course code	**: MICML-601**
Course Name	**:Lab Course Based on MICMC-501**
Semester	**: VI**

L	T	P	C
0	0	2	2

Practicals

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) of water sample.
3. Calculation of Total Solids (TS) of water sample.
4. Calculation of BOD of water sample.

5. Calculation of COD of water sample.
6. Bacterial Examination of Water by MPN Method.

Upon successful completion of the course a student will be able to

CO1	Define TDS,BOD,COD and MPN in water sample.
CO2	Explain, Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment.
CO3	Write about the concept of ecosystem, ecosystem organization and microbial community, air borne transmission of microbes, aquatic microbiology, Positive and negative interactions amongst microbial populations, Interactions between microorganisms and plants , Interactions between microorganisms and animals, various pollution and its control and Impact of Microbes on Environment
CO4	Explain Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO5	Summarize the study of Microbial Ecology, Air and Aquatic Microbiology, Microbial Interactions, Pollution and its Control, Impact of Microbes on Environment
CO6	Generalize the concept of Environmental Microbiology

B. Sc. Microbiology

Course code	**: MICMC-602**
Course Name	**:INFECTION AND IMMUNITY**
Semester	**: VI**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To learn about infection and infectious agents.

2.To learn about role of cells and molecules of immune system in infections.

3To gain knowledge about

Course Content

TOTAL HOURS: 48 **CREDITS: 03**

Unit I: Infectious Agents **No. of Hours: 12**

Infection and its types; Infectious agents: Viruses, Bacteria, Fungi, Protozoa, Helminthes(worms),Parasites,Prions;Pathogensandimmunity;Immunogenicityofpathogens ;Virulence and susceptibility; Pathogen associated molecular patterns.

Unit II: Immune Regulation of Infection **No. of Hours: 10**

Barriers preventing establishment of infection; Mechanism of establishment of infection:Invasion, Survival in intracellular and cytoplasmic space, Role of molecular factors inestablishment of infection, Role of cells and molecules of immune system in infection,Adoptive immunity to infection, Immune elimination of infection, Mechanisms of escapefrom immune-mediated destruction, Infection in immuno-compromised host.

Unit III: Immune Responses to Infection **No. of Hours: 08**

Immunealterationduringearlyandlatephasesofinfection;Immunologicalbasisofinfection;Infe ctionandantigenpresentation;Recognitionofmolecularpatternofpathogen;Phagocytosisandki llingofinfectiousagents;Humoralandcell-mediatedimmunity against infection; Infection associated immunosuppression; Immunodeficiencyandinfection;Acquiredimmuno-deficiencies;Nosocomialandcommunityacquiredinfections;Coinfections;Immunityinlocala ndsystemicinfection(Bacterimiaandviremia); Septic infection and immunity; Immunological memory against infection andsecondary responses; Immunization: Active and passive; Vaccination.

Unit IV: Immunity against Bacterial, Viral and Prions Infections No. of Hours: 09

Immune responses and immunological control of bacterial infection(*Staphylococcus* and*Mycobacterium*),viraldiseases(Influenzaandhepatitis)andprioninfections.

Unit V: Immunity against Fungal and Parasite Infections No. of Hours: 09

Immuneresponsesandimmunologicalcontroloffungalinfection(Candidiosisandaspergillosis) and parasitic diseases (Malaria, leishmaniasis, schistisomasis and filarisas).

Text Books:

1. Ananthanarayan,R.andPaniker,C.K.J.(2005).TextbookofMicrobiology.UniversityPress Publication, 7th ed.
2. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. (2013).Prescott's microbiology.

Reference Books:

1. BrooksGF,CarrollKC,ButelJSandMorseSA.(2013).Jawetz,MelnickandAdelberg'smedical microbiology. McGraw Hill Publication, 26th ed.
2. Goering,R.,Dockrell,H.,Zuckerman,M.andWakelin,D.(2007).Mims'medical microbiology. Elsevier, London, 4th ed.
3. Madigan,M.T.,Martinko,J.M.,Dunlap,P.V.andClark,D.P.(2014).Brockbiologyofmicroorganisms. Pearson International Edition, 14th ed.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define and memorize Infectious Agents, Immune Regulation of Infection, Immune Responses to Infection, Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO2	Discuss infection and its types, Infectious agents,pathogenicity etc., Immunologicalbasisof infection; Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO3	Write and explain about the basic concepts of infection and immunity such as infection ,immunological basis of infection, immunity against various infection etc.
CO4	Explain about infection, types, infectious agents, immunogenicity of pathogens, Immunologicalbasisof infection; Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO5	Summarize the idea of infection, infectious agents, Immune Responses to Infection, Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO6	Express the concept of infection and immunity.

B. Sc. Microbiology

Course code	**: MICML-602**
Course Name	**:Lab Course Based on MICMC-602**
Semester	**: VI**

L	T	P	C
0	0	2	2

Practicals

a. Study of mechanism of exosmosis andendosmosis.
b. Effect of isotonic, hypotonic and hypertonic solutions oncell.
c. Separation and preservation of serum andplasma.
d. Determination of blood group and Rhfactor.
e. Demonstration of agglutination reaction of bacterial cultures by slide .
f. Quantitative estimation of antigen by radialimmunodiffusion.
g. Detectionandquantificationofeitherantibodyorantigenbyouchterlonydoublediffusionmethod
h. Determination of concentration ofantigen byrocket immune electrophoresis.
i. Determination of the presence of specific antibody for its antigen by Dot-ELISAmethod.

CO1	Define and Bacterial, Viral Infections,
CO2	Discuss infection and its types, Infectious agents,pathogenicity etc., Immunologicalbasisof infection; Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO3	Write and explain about the basic concepts of infection and immunity such as infection ,immunological basis of infection, immunity against various infection etc.
CO4	Explain about infection, types, infectious agents, immunogenicity of pathogens, Immunologicalbasisof infection; Immunity against Bacterial, Viral and Prions Infections, Immunity against Fungal and Parasite Infections.
CO5	Summarize the Immunological tools ELISA,RIA etc.
CO6	Create the Effect of isotonic, hypotonic and hypertonic solutions oncell.

B. Sc. Microbiology

Course code	**: MICME- 603a**
Course Name	**:Genomics & Proteomics**
Semester	**: VI**

L	T	P	C
4	0	0	4

Course objectives: The broad objective of the course is to make students aware about the importanceofthemodernmethodsofgenomeandproteomeanalysisandthesignificanceoftheseonthe changing paradigm in genetics, medicine and agriculture. The specific objectives of the course are asfollows:

1. Tointroducethebasicconcepts ofgenomicsandnextgenerationsequencing.
2. Toacquaintstudentswithvariousgenomedatabasesandtheirapplications.
3. Tomakestudentsawareabouttheapplicationsofgenomicsinvariousindustries.
4. Tomake understand thetechniquesofproteomeanalysisdiverseapplicationsandbenefitsof genomeand proteomeanalysis.

UNIT I (15 Periods)

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II (10 Periods)

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III (20 Periods)

Introduction to protein structure, Chemical properties of proteins.Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT IV (15 Periods)

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data.

SUGGESTED READING AND TEXT BOOKS

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R.
4. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
5. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
6. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
8. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
9. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
10. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

CourseOutcomes(COs): On completion ofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define the** basic concepts of introduction to general character of genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO2	**Explain the** basicconcepts of genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO3	**IIllustrate the** featuresof Mass spectrometry based methods for protein identification, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO4	**Explain the**, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO5	**Summarize the** Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO6	**Create the**, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.

B. Sc. Microbiology

Course code	**: MICML- 603a**
Course Name	**:Genomics & Proteomics**
Semester	**: VI**

L	T	P	C
0	0	2	2

1. Web based servers and softwares for genome analysis.
2. Reterival of data by NCBI.
3. Study of protein structure byRasmole Software.
4. Sequencing of ompc protein of *Salmonella sp*. by SPVD Software.
5. Study of NCBI Web PAGE.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define the** basic concepts of Gene sequencing.
CO2	**Explain the FASTA AND BLASTA.**
CO3	**IIllustrate the** featuresof Bioinformatic tool in gene sequencing.

CO4	**Explain the**, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.
CO5	**Summarize the** Computer tools for sequencing projects.
CO6	**Create the**, Computer tools for sequencing, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.

B. Sc. Microbiology

Course code	**: MICME- 603a**
Course Name	**: MUSHROOM CULTURE TECHNOLOGY**
Semester	**: VI**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1.To make student aware about introduction, history and cultivation of mushrooms.
2. To gain knowledgeabout Poisonous and Non-poisonous Mushroom.
3. To learn about Marketing of mushrooms in India and world.

Course Content

TOTAL HOURS: 60 **CREDITS: 04**

UNIT-1 **No of Hours: 14**

Introduction,historyofmushroomcultivation;biologyofmushrooms;Nutritionalvalue:(Proteins, amino acids, mineral elements, carbohydrates, fibers, vitamins)Medicinal value ofmushrooms;PoisonousandNonpoisonousmushrooms,edibleandnonedibleMycorrhizalmushroo ms and their role in plant growth, mushrooms cultivation in India and world.

UNIT-2 **No of Hours: 08**

CultivationofbuttonMushroom,morphologyraisingapureculture&spawnpreparation.Preparation of compost &cultivation of Agaricus biosporus , Pleurotusflabeltus, harvest.

Unit-3 **No of Hours: 15**

CultivationTechnology:Infrastructure,equipmentsandsubstratesinmushroomcultivation:Polythene bags, vessels, inoculation hook, inoculation loop, love cost stove, sieves, culture racks,mushroom unit or mushroom house, water sprayer, tray, boilers, driers, pure culture,

Spawn:typesofspawn,preparationofspawn,mushroombedpreparationandfactorsaffectingmushroombedpreparation;Compost:materialsusedforcompostpreparation,composttechnology in mushroom production.

Unit-4 **No of Hours: 10**

PestsanddiseaseofedibleMushroom,Environmental,Fungal,Bacterial,ViralinsectpestandNematodes disease.

Unit -5 **No of Hours: 13**

Storage and food preparation from mushrooms: Methods of storage of mushroom cultivation ,LongtermandshorttermstorageofmushroomsFoods/recipesfrommushrooms;Mushroom research centers/farms: National level and regional level, Marketing of mushrooms in India andworld.

Text Books:

1. Arora, David (1991). All That the Rain Promises and More...: A Hip Pocket Guide toWestern Mushrooms. Berkeley: Ten Speed Press. ISBN 978-0-89815-388-0.

2. Marrone, Teresa (2016). Mushrooms of the Northeast: A Simple Guide to CommonMushrooms. Cambridge, MN: Adventure Publications. ISBN 978-1591935919.

3. Marrone,Teresa(2014). MushroomsoftheUpperMidwest:ASimpleGuidetoCommon Mushrooms. Cambridge, Minnesota: Adventure Publications, Inc. ISBN 978-1591934172.

Reference Books

1.MushroomCultivationTechnology,R.Gogoi,Y.Rathaiah,T.R.BorahScientificPublishers, 2019

4. Bessette, Alan (2019). Mushrooms ofthe Gulf Coast States. Austin, TX: University of Texas Press.ISBN978-1-471815-7.

5. Bessette, Alan (2007). Mushrooms oftheSoutheasternUnitedStates.Syracuse,N. Y: Syracuse University Press. ISBN 978-0815631125.

6. Kimbrough,James(2000). Common FloridaMushrooms.Gainesville,FL:University of Florida, Extension Institute of Food and Agricultural Sciences. ISBN 978-0916287306.

7. Metzler, Susan (1992). Texas Mushrooms : A Field Guide. Austin: University of TexasPress. ISBN 978-0292751262.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define biology of mushrooms, Pests and disease of edible Mushroom, and Methods of storage of mushroom.
CO2	Identify the Methods of storage of mushroom. Nutritional value diseases and Marketing of mushrooms in India and world.

CO3	Apply the knowledge of Nutritional value and Marketing of mushrooms in India and world and knowledge about Pests and disease of edible Mushroom.
CO4	Illustrate the method of storage of mushroom,and also knowledge about of Nutritional value of diseases.
CO5	Summarize the Principles of Mushroom culture technology and Mushroom research centers/farms: National level and regional level.
CO6	Justify the concept of Photogrammetry, Geoinformatics., Image Interpretation, DigitalImageProcessing.

B. Sc. Microbiology

Course code	**: MICML- 603b**
Course Name	**: Lab Course based on MICMC- 603b**
Semester	**: VI**

L	T	P	C
0	0	2	2

1. Identify the Methods of storage of mushroom. Nutritional value diseases and Marketing of mushrooms in India and world.
2. Method ofPests and disease of edible Mushroom, and Methods of storage of mushroom..
3. Study ofPrinciples of Mushroom culture technology
4. Mushroom research centers/farms: National level and regional level.

CO1	Define biology of mushrooms, Pests and disease of edible Mushroom, and Methods of storage of mushroom.
CO2	Identify the Methods of storage of mushroom. Nutritional value diseases and Marketing of mushrooms in India and world.
CO3	Apply the knowledge of Nutritional value and Marketing of mushrooms in India and world and knowledge about Pests and disease of edible Mushroom.
CO4	Illustrate the method of storage of mushroom,and also knowledge about of Nutritional value of diseases.
CO5	Summarize the Principles of Mushroom culture technology and Mushroom research centers/farms: National level and regional level.
CO6	Justify the concept of Photogrammetry, Geoinformatics., Image Interpretation, DigitalImageProcessing.

B. Sc. Microbiology

Course code	**: MICME- 604a**
Course Name	**:Bio-Analytical Tools**
Semester	**: VI**

L	T	P	C
4	0	0	4

Course objectives: The broad objective of the course is to make students aware about the importanceandsignificanceofthediversetoolsandtechniqueusedtostudyandunderstandthebiological world.The specificobjectives of thecourseareasfollows:

1. Tointroducethebasicprinciple,typesandapplicationofmicroscopy.
2. Tostudyconcepts applicationsandtypesofcentrifugation.
3. Toacquaintstudentswithchromatographyandspectroscopytechniques.
4. Tomakesstudentsunderstandthetechniquesofelectrophoresisandblotting.

UNIT I (10 Periods)

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy.

UNIT II (15 Periods)

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III (15 Periods)

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV (20 Periods)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting.Introduction to Biosensors and Nanotechnology and their applications**.**

SUGGESTED READING AND TEXT BOOKS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wiley&Sons.Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006.Cell and Molecular Biology.8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition.ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the basic concepts of introduction to general character of bio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques and Biosensors and Nanotechnology and their applications**.**
CO2	**Explain the** basicconcepts ofBiosensors and Nanotechnology and their applications**,** bio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques and cell fractionation techniques.
CO3	**Illstrate the** detailedprocessesandfeatures ofbio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.
CO4	**Explain** Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.
CO5	**Compare the**, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.
CO6	**Create a** Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.

B. Sc. Microbiology

Course code	**: MICME- 604a**
Course Name	**:Lab Course Based on MICME- 604a**
Semester	**: VI**

L	T	P	C
0	0	2	2

1.To determine the pH of the given sample.

2.Demonstration of Beer Lambert Law.

3.To determine the Rf value of given sample.

4.To perform the TLC in the given sample.

5.To perform the paper chromatography.

6. To lean the principle of SDSPAGE Electrrophoresis.

B. Sc. Microbiology

Course code	**: MICME- 604b**
Course Name	**:Bioinformatics**
Semester	**: VI**

L	T	P	C
4	0	0	4

UNIT-I Introduction to Bioinformatics. Fundamentals of computer and internet. Various protocols followed on internet. Applications of bioinformatics in microbiology.

UNIT-II Major biological databases. Protein, nucleic acid sequence and structure databases. Gene expression and metabolic pathway databases. Various file formats.

UNIT-III Sequence alignment algorithms, types and applications. Phylogenetic tree construction using various algorithms. Statistical significance of sequence alignment.

UNIT-IV. Validation of protein structure with emphasis on Ramachandran plot. Drug designing on prevalent diseases.

UNIT-V Microbial Bioinformatics Specialized Microbial Databases Metagenomics, Metatranscriptomics, Metabolomics and Systems Biology Host pathogen interaction Comparative genomics and proteomics of microbes Microbial Bar Coding and Bioinformatics

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the Fundamentals of computer and internet, Major biological databases, Sequence alignment algorithms, Protein and nucleic acid structure and function prediction, Microbial Bar Coding and Bioinformatics.
CO2	Explain thebasicconceptsBioinformatics, Gene expression and metabolic pathway databases, Statistical significance of sequence alignment. Drug designing on prevalent diseases, Comparative genomics and proteomics of microbes.
CO3	Illstrate thedetailedprocessesandfeatures ofApplications of bioinformatics in microbiology, Gene expression and metabolic pathway databases. Statistical significance of sequence alignment. Drug designing on prevalent diseases. Comparative genomics and proteomics of microbes.
CO4	Explain Comparative genomics and proteomics of microbes, Microbial Bar Coding and Bioinformatics, Gene expression and metabolic pathway databases, Drug designing on prevalent diseases. Comparative genomics and proteomics of microbes.
CO5	Compare theGene expression and metabolic pathway databases, Protein and nucleic acid structure and function, Drug designing on prevalent diseases.
CO6	Create a Statistical significance of sequence alignment, Comparative genomics and proteomics of microbes, Gene expression and metabolic pathway databases, significance of sequence alignment.

B. Sc. Microbiology

Course code	**: MICME- 604b**
Course Name	**:Lab Course Based on MICME- 604b**
Semester	**: VI**

L	T	P	C
0	0	2	2

1. IdentificationofunknownsequencebyBLASTanditsfunctionalannotation.
2. SNPanalysisusingSNP databaseofNCBI.
3. Comparisonofgenomesoftware organismsusingSynMapofCoGe.
4. Demonstrationofmicroarrayapplicationsandanalysisofmicroarraydata.
5. ComputationofpIandmolecularweightofaproteinusingExPASyProtParamtool.
6. Demonstrationof2DPAGEanddataanalysis.
7. GenerationofproteininteractionnetworksusingSTRINGsoftware.
8. SubcellularproteinlocalizationstudyusingCELLOtool.
9. ProteinmodificationusingMEMEsoftware.
10. ConserveddomainanalysisusingNCBIbatch-CDresearch.

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the basic concepts of introduction to general character of bio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques and Biosensors and Nanotechnology and their applications**.**
CO2	**Explain the** IdentificationofunknownsequencebyBLASTanditsfunctionalannotation. SNPanalysisusingSNP databaseofNCBI.Basicconcepts ofBiosensors and Nanotechnology and their applications**,** bio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques and cell fractionation techniques.
CO3	**Illstrate the** detailedprocessesandfeatures ofbio-analytical, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.

CO4	**Explain** Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.
CO5	**Compare the**, Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.
CO6	**Create a** Simple microscopy, Principle and law of techniques, Introduction to the principle of chromatography, electrophoresis, blotting techniques, Biosensors and Nanotechnology and their applications and cell fractionation techniques.

B. Sc. MICROBIOLOGY

Course code	**:COCCR- 605**
Course Name	**:Medical Microbiology**
Semester	**: VI**

L	T	P	C
2	0	0	0

Courseobjectives: Theobjectiveofthiscourseis:

1. Tointroducebasicprinciplesandapplicationrelevanceofmicrobiologicaldiseases
2. Togaintheknowledgeaboutthebacterialagents responsibleforinfectiousdiseases.
3. Tounderstandthepathologyofthevirusesandfungaldiseases.
4. Togaintheknowledgeabout laboratory diagnosis

UNIT I (15 Periods)

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock,

septicemia, pathogenicity, virulence factors, toxins, biosafety levels.Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy

of Gram positive bacteria.Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy

caused by gram negative bacteria.

UNIT II (15 Periods)

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses,

Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis

viruses.Fungal and Protozoan infections.Dermatophytoses, Subcutaneous infection, systemic infectionand opportunistic fungal infections.Gastrointestinal infections and Blood-borne infections

SUGGESTED READINGS

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Ja**wetz, Melnick and Adelberg's** Medical Microbiology. 24th edition. McGraw Hill Publication.
2. **Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology.** 4th edition.Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. **(2008). Prescott, Harley and Klein's** Microbiology. 7th edition. McGraw Hill Higher Education.

CO1	Identify and Memorizethe Biosafety guidelines and biosafetylevels.
CO2	Production, monitoring, Estimation of wine.
CO3	Determination the Isolation, biochemicalcharacterization and antimicrobial susceptibility of pathogenic bacteria/fungi /clinical specimens.
CO4	Perform an experiment to determine MIC and MBC concentration of antibiotics by broth dilutiontest.
CO5	Estimate enzyme productionby bacterial and fungal cultures.
CO6	Formulation of media for enzyme production by microbial cultures.

B. Sc. Microbiology

Course code	**: MICPE 606**
Course Name	**:Project/Educational Tour Report II**
Semester	**: VI**

L	T	P	C
0	0	0	3

Course Objectives: The objectives of this course are

4. To make the students industry, university and research institute deployable.
5. To provide an opportunity to students to gain practical knowledge.
6. To provide an opportunity to pursue higher education in reputed organization across the globe.

Every student must enroll for project/ under the guidance of faculty member/supervisor from industry/research organizations or submit an educational tour report by the guidance of internal supervisor. Students will have to submit project work and will be evaluated at the end of the semester followed by presentation and viva. The thesis will be evaluated internally by a panel of examiner.

Suggested Readings: NA

Course Outcome:

CO1.	demonstrate the analytical, practical training and understand the scope and importance of Biotechnology through exposure.
CO2.	**Explain** basicconcepts interpretation and organization of data.
CO3.	**Illustrate the** develop thesis writing skills and Project/Educational Tour Report.
CO4.	**Explain the** features of develop thesis writing skills and Project/Educational Tour Report.
CO5.	**Summarize the** features of develop thesis writing skills and Project/Educational Tour Report.
CO6.	**Create the** develop thesis writing skills and Project/Educational Tour Report.

Degree Course in Honours Microbiology [B.Sc. (Hons.) Microbiology]

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICMC- 701**
Course Name	**: BACTERIOLOGY**
Semester	**: VII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

To developknowledge and understanding of the core concepts in the discipline of bacteriology.

UNIT-1 Cell organization No. of Lecture-12

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,

Archaebacterial 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 archaealcellmembranes.Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids,Endospore: Structure, formation, stages of sporulation.

UNIT-II **Bacteriological techniques** **No. of Lecture-12**

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

UNIT-III**Growth and nutrition** **No. of Lecture-12**

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*Physical methods of microbial control*: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation*Chemical methods of microbial control*: disinfectants, types and mode of action.

UNIT-IV **Reproduction in Bacteria** **No. of Lecture-12**

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate, synchronous and diauxic growth.

UNIT V **Bacterial Systematics** **No. of Lecture-12**

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, signature sequences.Differences between eubacteria and archaebacteria

Suggested Books:

. Textbook of Microbiology- Ananthanarayan and Paniker.The Orient Blackswan; 10th Revised edition

2.General Microbiology 2Ed (Revised)- SB Sullia. Oxford & IBH Publishing; 2nd Revised edition

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Understand the morphology, ultrastructure, organelles and different forms of bacterial cells
CO 2	Apply the knowledge of bacteriological techniques
CO 3	Develope the understanding related to nutritional and physical requirements for bacterial growth
CO 4	Describe the principles involved in killing bacteria, and make recommendations on use of physical and chemical methods used to control microbial growth
CO 5	Analyze the dynamics of the growth of a bacterial population and how this growth can be measured.
CO6	Justify the cell structure , growth ,function and reproduction

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICML- 701**
Course Name	**: BACTERIOLOGY**
Semester	**: VII**

L	T	P	C
2	0	0	2

1. Preparation of different media: Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining,Gram's staining,Capsule staining,Endospore staining,
3. Isolation of pure cultures of bacteria by streaking method.
4. Estimation of CFU count by spread plate method/pour plate method
5. Motility by hanging drop method

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Memorize Safetyrulesofworkingand recognize different instruments used in microbiology Laboratory and enumeratetotalviablecountinwater/soilsample.
CO 2	Identify different types of bacteria and fungi on the basis of different staining techniques.
CO 3	Prepare different types of solid and liquid media.
CO 4	DifferentiatebetweenlactosefermentorandnonfermentoronMacConkeyagar.
CO 5	Assess characteristicfeaturesof*Aspergillus,Penicillium,Amoeba*and*Paramaecium* Andcolonymorphologyof*E.coli*onEMB Agar.
CO6	Prepare isolationofpureculture ofbacteria.

B. Sc. (Hons.) Biotechnology

Course code	**: MICMC-702**
Course Name	**: VIROLOGY**
Semester	**: VII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

To give an overview of medically important viruses, their modes of replication, and mechanism of viral infection and their prophylaxis.

UNIT-1 Nature and Properties of Viruses **No. of Lecture-12**

Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses. Isolation, purification and cultivation of viruses.

UNIT-IIBacteriophages **No. of Lecture-12**

Diversity, classification, one step multiplication curve, lytic (T4) and lysogenic phages (lambda phage)concept of early and late proteins, regulation of transcription in lambda phage

UNIT-IIIAnimal Virus **No. of Lecture-14**

Epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses - Picorna, Orthovirus, myxovirus, Paramyxovirus, Togavirus, Rhabdovirus, Rotavius, DNA viruses: Pox virus, Herpes virus, Adenovirus, SV40 virus, Hepatitis B virus

UNIT-IVPlant virus **No. of Lecture-12**

Effects of viruses on histology, physiology and cytology of plants.Common viral diseases of plants.Transmission of plant viruses, virus indexing, and production of virus free plants.**Prevention and control of viral diseases** Antiviral compounds and their mode of action, Interferon and their mode of action, General principles of viral vaccination.

Suggested Readings

1. Wiley, J.M., Sherwood, L.M. and Woolverton, C.J. Prescott, Harley and Klein's microbiology. McGraw-Hill, New York.
2. Black, J.G. Microbiology: Principles and exploration. John Wiley and Sons, New Jersey.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Microbiology. McGraw-Hill, New York.
4. Dimmoc, N.J., Easton, A.J. and Leppard, K.N. Introduction to modern virology. Wiley-Blackwell, New Jersey.
5. Primrose, S.B. Introduction to modern virology. John Wiley and Sons, New Jersey.
6. Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin/Cummings Publishing Company, San Francisco.
7. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. William C. Brown, Dubuque.
8. Aneja, K.R. Experiments in microbiology, plant pathology and biotechnology. New Age International (P) Limited, New Delhi.
9. Kannan, K. Laboratory manual in general microbiology. Panima, New Delhi.
10. Atlas, R.M., Brown, A.E. and Parks, L.C. Laboratory manual of experimental microbiology. Mosby College Publishing Company, St. Louis

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Memorize Safetyrulesoworkingand recognize different instruments used in microbiology Laboratory and enumeratetotalviablecountinwater/soilsample.
CO 2	Identify and morphological detection of different types of bacteria and fungi ,viral disease on the basis of different spotting..
CO 3	Prepare different types of solid and liquid media.
CO 4	DifferentiatebetweenlactosefermentorandnonfermentoronMacConkeyagar.
CO 5	Assess characteristicfeaturesof*Aspergillus*,*Penicillium*,*Amoeba*and*Paramaecium* Andcolonymorphologyof*E.coli*onEMB Agar.
CO6	Prepare isolationofpureculture ofbacteria.

B. Sc. (Hons.) Biotechnology

Course code	**: MICML-702**
Course Name	**:VIROLOGY LAB**
Semester	**: VII**

L	T	P	C
2	0	0	2

Course Objectives: The objectives of this course are

To develop knowledge and understanding of viral isolation and cultivation methods, and the common serological techniques followed in laboratory diagnosis of viral infection.

1. Isolation a colipahges from sewage water sample.

2. Isolation of Microrganism from leaves.

3. Study of Morphological detection of different Viral disease.

4.Study of Viral protein by SPVD Software.

Uponsuccessfulcompletionofthecourseastudentwill beableto

CO 1	Memorize Safetyruleso fworkingand recognize different instruments used in microbiology Laboratory and enumerate total viablecountinwater/soilsample.
CO 2	Identify and morphological detection of different types of bacteria and fungi ,viral disease on the basis of different spotting..
CO 3	Prepare different types of solid and liquid media.
CO 4	DifferentiatebetweenlactosefermentorandnonfermentoronMacConkeyagar.
CO 5	Assess characteristicfeaturesof*Aspergillus*,*Penicillium*,*Amoeba*and*Paramaecium.* Andcolonymorphologyof*E.coli*onEMB Agar.
CO6	Study of Viral protein by SPVD Software.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICME-703a**
Course Name	**:MICROBIAL ANALYSIS OF AIR &WATER**
Semester	**: VII**

L	T	P	C
4	0	0	4

CourseObjectives:Theobjectivesofthiscourseare

1. **Todevelopanunderstandingaboutairbornemicroorganismsandtheirimpactonhuman health.**
2. **Togainknowledgeaboutwaterbornepathogens,waterbornediseasesandmicro biological analysisofwater.**
3. **Todevelopcuriositytocontrolairandwaterpollution.**

CourseContent

TOTALHOURS:60 **CREDITS:04**

UnitI:Aeromicrobiology No.ofHours:16

Bioaerosols;Airbornemicroorganisms(Bacteria,virusesandfungi)andtheirimpacton Humanhealthandenvironment;Significanceinfoodandpharmaindustriesandoperation theatres;Allergens.

UnitII:CollectionandAnalysisofAirSample No.ofHours:07

Bioaerosolsampling;Airsamplers;Methodsofsamplingandanalysis;C ulturemediaforbacteriaandfungi;Identificationcharacteristics.

UnitIII:WaterMicrobiology

Water-bornepathogens;Water-bornediseases **No.ofHours:07**

UnitIV:MicrobiologicalAnalysisofWater No.ofHours:15

Samplecollection,Treatmentandsafetyofdrinking(potable)water,Waterpurification,Met hodstodetectpotabilityofwatersamples:(a)Standardqualitativeprocedure(MPNtest)(b)M embranefiltertechniqueand(c)Presence/absencetests

UnitV:ControlMeasures No.ofHours:15

Air:Fateofbioaerosols;Inactivationmechanisms(U.V.light,H.E.P.Afilters,desiccationand incineration);Water:Precipitation,Chemicaldisinfection,Filtration,Hightemperatureand U.V.lighttreatment.

TextBooks:

TB1. Atlas,R.M.andBartha,R.Microbialecology:Fundamentalsandapplications.B enjamin/CummingsSciencePublishing,USA.

TB2. Evans,G.M.andJohn,J.C.F.Environmentalbiotechnology:Theoryandapplications.J ohnWileyandSons,NewYork.

ReferenceBooks:

RB1. DaSilva,N.,Taniwaki,M.H.,Junqueira,V.C.,Silveira,N.,Nascimento,M.S.,Gomes, R.A.R.Microbiologicalexaminationmethodsoffoodandwater:Alaboratorymanual.CRC Press,BocaRaton.

RB2. Madigan,M.T.,Martinko,J.M.andParker,J.Brockbiologyofmicroorganisms.Prenti ceHall,New Jersey.

RB3. Mitchell,R.andGu,J.D.Environmentalmicrobiology.Wiley-Blackwell,NewJersey.

RB4. Maier,R.,Pepper,I.andGerba,C.Environmentalmicrobiology.AcademicPress,San Diego.

RB5. Hurst,C.J.,Crawford,R.L.,Garland,J.L.,Lipson,D.A.,Mills,A.L.andStetzenbach, L.D.Manualofenvironmentalmicrobiology.ASMPress,Washington,D.C.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Identify and examine air borne microorganisms,AirSample, Watersample,ControlMeasures.
CO 2	Summarize the impact of air borne, water borne pathogens and their impact on human and environment
CO 3	Determine sampling , collection methods and control measures for air borne and water borne pathogens
CO 4	Explain air borne and water borne pathogens.
CO 5	Consider different sampling, collection and control measures for air borne and water borne microorganisms.
CO6	Generalize the concept of air and water microbiology.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICML-703a**
Course Name	**:MICROBIAL ANALYSIS OF AIR &WATER**
Semester	**: VII**

L	T	P	C
2	0	0	2

1 Isolation andIdentify and examine air borne microorganisms,AirSample, Watersample,ControlMeasuresof Microrganism from air.

2. Study ofair borne and water borne pathogens

3. collection and sampling of air borne and water borne microorganisms.

4. Identify and examine air borne microorganisms

CO 1	Identify and examine air borne microorganisms,AirSample, Watersample,ControlMeasures.
CO 2	Summarize the impact of air borne, water borne pathogens and their impact on human and environment
CO 3	Determine sampling , collection methods and control measures for air borne and water borne pathogens
CO 4	Explain air borne and water borne pathogens.
CO 5	Consider different sampling, collection and control measures for air borne and water borne microorganisms.
CO6	Generalize the concept of air and water microbiology.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICME-703b**
Course Name	**:MYCOLOGY**
Semester	**: VII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

Learning about the detailed structure (morphology and microscopy) and characteristics of fungi.

No. of Lecture-12

UNIT-IHistory of Mycology,Classification of fungi,Morphology, microscopy and structure of fungi,

No. of Lecture-14

UNIT-II General Overview Phylums:-Chytridiomycota (The chytrids),Zygomycota (The conjugated fungi),Ascomycota (The sac fungi),Basidiomycota (The club fungi) Deutromycota (The imperfectifungi,Zygomycota (The conjugated fungi,Ascomycota (The sac fungi),Basidiomycota (The club fungi),

No. of Lecture-12

UNIT-IIIDeutromycota ,Symbiotic association of fungi,Nutrition requirements. Symbiotic association of fungi,Nutrition requirements

UNIT-IV Rusts and Smuts,Fungal disease of plants and humans**No. of Lecture-12**

No. of Lecture-12

UNIT- VApplication of fungi (Mushroom, *Penicillium, Aspergillus, Monasus, Trichoderma*) in various industrial sector.

TextBooks:

TB1. Atlas,R.M.andBartha,R.Microbialecology:Fundamentalsandapplications.Benjamin/CummingsSciencePublishing,USA.

TB2. Evans,G.M.andJohn,J.C.F.Environmentalbiotechnology:Theoryandapplications.JohnWileyandSons,NewYork.

ReferenceBooks:

RB1. DaSilva,N.,Taniwaki,M.H.,Junqueira,V.C.,Silveira,N.,Nascimento,M.S.,Gomes, R.A.R.Microbiologicalexaminationmethodsoffoodandwater:Alaboratorymanual.CRC Press,BocaRaton.

RB2. Madigan,M.T.,Martinko,J.M.andParker,J.Brockbiologyofmicroorganisms.Prenti ceHall,New Jersey.

RB3. Mitchell,R.andGu,J.D.Environmentalmicrobiology.Wiley-Blackwell,NewJersey.

RB4. Maier,R.,Pepper,I.andGerba,C.Environmentalmicrobiology.AcademicPress,San Diego.

RB5. Hurst,C.J.,Crawford,R.L.,Garland,J.L.,Lipson,D.A.,Mills,A.L.andStetzenbach, L.D.Manualofenvironmentalmicrobiology.ASMPress,Washington,D.C.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Identify and examine air borne microorganisms,AirSample, Watersample,ControlMeasures.
CO 2	Summarize the impact of air borne, water borne pathogens and their impact on human and environment
CO 3	Determine sampling , collection methods and control measures for air borne and water borne pathogens
CO 4	Isolation of air borne and water borne pathogens from PDA Plate.
CO 5	Consider different sampling, collection and control measures for air borne and water borne microorganisms.
CO6	Generalize the concept of air and water microbiology.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICML-703b**
Course Name	**:MYCOLOGY**
Semester	**: VII**

L	T	P	C
2	0	0	2

1. Isolation of fungi from soil.
2. To study cultivation and preservation of fungus under laboratory conditions
3. Isolation of fungi from fungal infected fruits or bread
4. To study morphology, microscopy of isolated fungi
5. Various enzyme production by fungi (plate assay)
6. Effect of pH and temperature on fungus

CO 1	Identify and examine fungus in leaves..
CO 2	Isolation of fungus by leaf impression method.
CO 3	Islation of fungus by pure culture technique.

CO 4	Isolation of air borne and water borne pathogens from PDA Plate.
CO 5	Study of various fungal disease ..
CO6	Study of Various enzyme production by fungi (plate assay).

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICOE-704**
Course Name	**MOLECULAR VIROLOGY &INFECTION-I**
Semester	**: VII**

L	T	P	C
2	0	0	2

Course Objectives: The objectives of this course are

Course Objectives: The objectives of this course are

1. **To learn about morphology Plant and animal viruses.**
2. To gain knowledge about PCR Techniques.
3. To learn about Interferon.

Course Content

TOTAL HOURS: 60 **CREDITS: 02**

UNIT – I **No. of Hours: 12**

HistoryofVirologyandBiosafety:Historyandprinciplesofvirology,virustaxonomy. Structuresofanimalandplantvirusandtheirmorphology.Principlesofbiosafety,containmentfacilities,maintenanceandhandlingoflaboratoryanimals,andrequirementsofvirologylaboratory.

UNIT – II **No. of Hours: 14**

Virus Replication: Structure and replication strategies of bacteriophages - T7, λ, ΦX174, andplant viruses - ss RNA virus (TMV) and ds DNA virus (CaMV). Structure and replicationstrategies of animal viruses - Influenza virus, Adeno virus and Retrovirus ,Corona Virus.Inductionofinterferon.Antiviralagents(chemical and biological) and their mode of actions.

Text Books:

1. Rothman, K.J. and Greenland, S. Modern epidemiology. Lippincott-Raven, Philadelphia.
2. Dockrell,H.,Zuckerman,M.,Roitt,I.M.andChiodini,P.L.Mim'smedicalmicrobiology.Elsevier ,London
3. Gordis, L. Epidemiology. Saunders, Philadelphia.
4. Anderson,R.M.andMay,R.M.Infectiousdiseasesofhumans:Dynamicsandcontrol.OxfordUniversity Press, Oxford

.

Reference Books

1. Giesecke, J. Modern infectious disease epidemiology. Edward Arnold, London
2. Clayton,D.andHills,M.Statisticalmodelsinepidemiology.OxfordUniversityPress,Oxford.
3. RothmanK.J.,Greenland,S.andLash,T.L.Modernepidemiology.LippincottWilliamsand Wilkins,Philadelphia

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn about molecular basis of viral infection.
CO2	Discuss about history, cultivation,replication and virological method of viruses.
CO3	Write about viruses structure, replication, cultivation and antiviral agent.
CO4	Explain the viral infection,cultivation,antiviral agent and VirologicalMethods.
CO5	Summarize the steps of viruselife cycle with reference to antiviral agent .
CO6	Compilethe infection of viruses and Molecular diagnostic tools used in detection of viral infection.

B. Sc. (Hons.) Microbiology

Course code	**: MICVO-705**
Course Name	**:Pharmaceutical Biotechnology & Drug Designing**
Semester	**: VII**

L	T	P	C
3	0	0	3

Course Objectives: The objectives of this course are

1. To understand the Concept, Need and Importance of Biotechnology in Pharmaceutical Biotechnology & Drug Designing.
2. To demonstrate the scientific method and the use of problem-solving within the field of Pharmaceutical Biotechnology & Drug Designing.
3. To develop scientific knowledge regarding vaccines and role of biotechnology in development of pharmaceutical drugs.
4. To demonstrate the scientific method and the use of Drug targeting and drug delivery systems.

Couse Contents [Credit - 4]

Unit 1 **No. of lecture-12**

Delivery considerations of biotechnological products: Introduction, Stability profile, Barriers to proteins and peptide delivery, Delivery of protein & peptide drugs, Lymphatic transportation of proteins, Site specific protein modification(protein engineering), Toxicology profile characterization.

Unit 2No. of lecture-12

Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting. Ligands as means of targeting, Blood cell receptors for endogenous compounds, Carrier system for targeting, Vesicular systems for ligand mediated drug targeting, Specialized liposomes for cellular drug targeting.

Unit 3No. of lecture-14

Vaccines: Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.

Unit 4No. of lecture-12

Introduction to drug design cycle: Structure Activity Relationship (SAR), Rational Drug Design, Pharmacophoric patterns, Quantitative Structure-Activity Relationship. (Q SAR) &Hans equation.

Unit 5No. of lecture-12

Introduction to molecular modeling: Quantum mechanical and molecular orbital methods, Introduction to semiempirical, molecular mechanics and ab initio techniques. Potential energy surface, Docking and modeling substrate – receptor interactions. Introduction to s/w tools for CADD.

Suggested Reading and Text Books

1. Leon Lachman. Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986 .
2. Remington's Pharmaceutical Science, Mark Publishing and Co.

CourseOutcomes(COs): On completion ofthiscourse,thestudentswillbe:

CO	Description
CO1	**Define and Explain** introduction to Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling.
CO2	**Explain the** basic principle components of tools and techniques in the field of Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling and their utilization to solve the society and industry-related problems.
CO3	**Illustrate the** modern techniques in Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling.related research institution.decision making for higher studies, employment and advanced research in industrial and academic scale.
CO4	**Explain the** demonstrate the scientific knowledge ofPharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling. Knowledge of the pharmaceutical sciences and drug designing in biological systems information and the explanation of the key concepts.
CO5	**Summarize the** understandingthe principle, methods, properties and functions of Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling. Knowledge of the pharmaceutical sciences and drug designing in biological systems information and the explanation of the key conceptsand applications in health, agriculture and environment, alongwith associated social and environmental issues.
CO6	**Create a** scientific knowledge regarding Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modeling. Knowledge Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**:COCCR-706**
Course Name	**: Biomedical Technology**
Semester	**: VII**

L	T	P	C
3	0	0	3

Course Objectives: The objectives of this course are

1. To learn about Autoimmunediseases.
2. To gain the knowledge about molecular diagnosis of cancer.
3. To knowledge about Mutations and genetic disorders

Course Content

TOTAL HOURS: 48 **CREDITS: 03**

UNIT I **No of Hours:12**

CellularPathology:causesofcellinjury,necrosis,biochemicalmechanism,Ischemicandhypoxic injury. Apoptosis (Biochemical features, mechanisms) Immunological basis of diseases:Hypersensitivity(I–IV)AutoimmunediseasesPreparationofpolyclonalantisera:characterization of antisera, Immuno diagnostic – RIA, ELISA.

UNIT II No of Hours-10

Mutationsandgeneticdisorders.Singlegenedisorders,Receptorproteins(hypercholesterolemia). Cytogenicdisorders(Trisomy,Klienfelters).Mutationinmitochondrial genes (LHDN),Fragile XSyndrome.

.

UNIT III No of Hours-08

Types and grading of cancer. Introduction to molecular diagnosis of cancer.(Southern &Northernblotanalysis,PCRbaseddiagnosis).Genetherapy,Immunotherapyandche motherapy of cancer cells.

UNIT IV No of Hours-09

Chemical mutagens.Carcinogenic agents and their cellular interactions.Radiationashealth hazard. (Types,measurements,effects&protective measures)Introduction toDNA damage and Types of DNA repair mechanism.

UNIT V No of Hours-09

Molecular diagnosis (genetic disease, gene diagnosis, gene tracking & other diagnosticapplication of RDT) Molecular diagnostic- direct gene diagnosis, Linkage analysis.Nucleic acid sequences as diagnostic tools, SNPs, VNTRs, Non-invasive methodology.MRI, CT-SCAN. Reproductive Health Technologies – ICSI,IVE.

Text Books:

1. **1.**Krebs,J.E.,Goldstein,E.S.andKilpatrick,S.T.Lewin'sgenes.JonesandBartlett, Learning Publishers, Sudbury
2. Chaitanya, K.V. Cell and molecular biology: A lab manual. PHI Learning, New Delhi.

Reference book

1. Snustad,D.P.andSimmons,M.J.Principlesofgenetics.JohnWileyandSons,NewY ork.
2. Lodish,H.,Berk,A.,Kaiser,C.A.,Krieger,M.,Scott,M.P.,Bretscher,A.,Ploegh,H.a nd Matsudaira, P. Molecular cell biology. W.H. Freeman and Company, New York.
3. Synder,L.J.,Peters,E.,Henkins,T.M.andChampness,W.Moleculargeneticsofbact eria.ASM Press, Washington, D.C.
4. Maloy,S.R.,Cronan,J.E.andFreifelder,D.M.Microbialgenetics.JonesandBartlett Learning, Sudbury.
5. Sambrook,J.andRussell,D.W.Molecularcloning:Alaboratorymanual.ColdSprin gHarbor Lab Press, New York.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Define CellularPathology, Mutationsandgeneticdisorders, Molecular diagnosis of infection.
CO2	Identify the Cellular Pathology, , Types and grading of cancer, Chemical mutagens and Molecular diagnosis of infection.
CO3	Apply the Immuno diagnostic tools in infection ,Immunotherapyandchemotherapy of cancer cells. Singlegenedisorders,mutation and repair mechanism.

CO4	Illustrate the. Immunotherapyandchemotherapy of cancer cells, Cellular Pathology, mutation and repair mechanism.
CO5	Summarize the Immunological basis of diseases, Gene therapy, Immuno therapy and chemotherapy of cancer cells.
CO6	Justify the Autoimmunedisease, Mutationsandgeneticdisorders and Cellular Pathology.

B. Sc. (Hons.) Microbiology

Course code	**: MICMC- 801**
Course Name	**:Epidemology**
Semester	**: VIII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To instill detailed study of the molecular and cellular components that comprises the immune system including their function and interaction to provide a lifelong learning & disciplinary knowledge to implement the concepts.
2. To appraise study of the different analytical techniques for the disease diagnosis, assist advancement and career options in the field of molecular diagnostics and applicate as well emerge with the solutions concerned with health and environment.
3. To broaden the area of understanding the structure, function, components of immune system for better advancement & comprehend the need of tools & techniques with broadening the area in distinguished fields.
4. To comprehend the essential elements of immune system clearing up the facts of theoretical and technical aspects and help in employing the scientific knowledge for development of medical interventions.

Unit 1 **No. of lecture-12**

Overview of the Immune System.Cells and Organs of the Immune System.Antigens.Haptens& Epitopes.

Unit 2No. of lecture-12

Immunoglobulins: Structure and Function. Major Histocompatibility Complex. Antigen processing and presentation.Structure and functions of BCR & TCR.

Unit 3No. of lecture-12

Cytokines. Complement System. Cell mediated cytotoxicity: Mechanism of T cell & NK cell mediated lysis. Ab-dependent cell mediated cytotoxicity (ADCC).

Unit 4No. of lecture-12

Overview of Hypersensititivity and Introduction to Transplantation. Vaccines: Active and Passive Immunization.

Unit 5No. of lecture-12

Introduction to Monoclonal Antibodies and polyclonal Antibodies. Antigen-Antibody Interactions RIA, ELISA, Western Blotting, Immuno precipitation, Immuno-fluorescence.

Suggested Reading and Text Books

5. Kuby : Immunology (4th ed.)
6. Roitt, Male &Brostof : Immunology (3rd ed).
7. Elgert&Elgert : Immunology
8. Wilson & Walker: Practical Biochemistry (4thed.)

Upon successful completion of the course a student will be able to

CO1	Describe the basic concept of epidemiology, disease transmission and control of epidemics.
CO2	Comprehend the scope and applications of epidemiology in study of disease transmission.
CO3	Analyze and interpret data on health surveillance
CO4	Analyze the pattern of disease spread and their control.
CO5	Recommend methods to prevent disease outbreaks by studying disease transmission dynamics and health surveillance according guidelines of public health organizations
CO6	Hypothesize the cause and pattern of disease spread.

B. Sc. (Hons.) Microbiology

Course code	**: MICML- 801**
Course Name	**:Epidemology**
Semester	**: VIII**

L	T	P	C
2	0	0	2

1.Study of composition and use of important differential media foridentification of bacteria: EMBAgar, McConkey agar, Mannitolsalt agar,
Study of bacterial flora of skin by swab method

2.Perform antibacterial sensitivity by Kirby-Bauer method

3.Identification of human blood groups.

4.To perform Total Leukocyte Count of the given blood sample.

5.To perform Differential Leukocyte Count of the given bloodsample.

Upon successful completion of the course a student will be able to

CO1	Describe the basic concept of epidemiology, disease transmission and control of epidemics.
CO2	Comprehend the scope and applications of epidemiology in study of disease transmission.

CO3	Analyze and interpret data on health surveillance
CO4	Analyze the pattern of disease spread and their control.
CO5	Recommend methods to prevent disease outbreaks by studying disease transmission dynamics and health surveillance according guidelines of public health organizations
CO6	Hypothesize the cause and pattern of disease spread.

B. Sc. (Hons.) Biotechnology

Course code	**: MICMC -802**
Course Name	**: Management of Human Microbial Diseases**
Semester	**: VIII**

L	T	P	C
4	0	0	4

CourseObjectives:Theobjectivesofthiscourseare

1. **Todevelopawarenessaboutmicrobial,non-microbial,humanDiseases.**
2. **Createawarenessaboutsocialissuesrelatedtomicrobialdiseases.**
3. **Toknowaboutthereasonsfordiseaseoutbreakandwilllearnmeasurestocontrolan deradicatethem.**

CourseContent

TOTALHOURS:60 **CREDITS:04**

UnitI:HumanDiseases No. of lecture-12

Infectiousandnon-infectiousdiseases;Microbialandnon-microbialdiseases;Deficiency diseases;Occupationaldiseases;Incubationperiod;Mortalityrate;Nosocomialinfections.

UnitII:MicrobialDiseases No. of lecture-14

Respiratory microbial diseases; Gastrointestinal microbial diseases; Nervous system diseases;Skin diseases; Eye diseases; Urinary tract diseases; Sexually transmitted diseases: Types, routeof infection, clinical systems and general prevention methods; Mosquito borne disease: Typesandprevention.

UnitIII:DiseaseOutbreaksandCancer No. of lecture-12

Study of recent outbreaks of human diseases (SARS, Swine flu, Ebola): Causes, spread andcontrol;Cancers:Types,Causes,Prevention,Detection,Treatment.

UnitIV:MicrobialDiseasesandSocietalIssues No. of lecture-12

Importanceofpersonalhygiene(TyphoidMary);Judicioususeofantibiotics;Importanceof

completingantibiotic regimen; Emergence of antibiotic resistance; Current issues of MDR/XDRmicrobialstrains.

UnitV:Vaccines

Importance;Typesofvaccines;Vaccinesavailableagainstmicrobialdiseases;Vaccination schedule(Compulsoryandpreventive)inIndiancontext.

TextBooks:

TB1. Ananthanarayan,R.andPaniker,C.K.J.(2009).Textbookofmicrobiology.U niversityPressPublication,8thed.

ReferenceBooks:

RB1. Brooks,G.F.,Carroll,K.C.,Butel,J.S.,Morse,S.A.andMietzner,T.A.(2013) .Jawetz,MelnickandAdelberg'sMedicalmicrobiology.McGrawHillPublication ,26thed.

RB2. Goering,R.,Dockrell,H.,Zuckerman,M.andWakelin,D.(2007).Mims'Me dicalmicrobiology.Elsevier, London,4thed.ccc

RB3. Willey,J.M.,Sherwood,L.M.andWoolverton,C.J.(2013).Prescott,Harleyan dKlein'sMicrobiology.McGrawHillHigherEducation,9thed.

RB4. Madigan,M.T.,Martinko,J.M.,Dunlap,P.V.andClark,D.P.(2014).Brockbio logyofmicroorganisms.PearsonInternationalEdition,14thed.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Identify and name Human diseases, microbial diseases, disease outbreak, social issues related to microbial diseases and vaccines.
CO 2	Discuss about infectious and non-infectious diseases, microbial and non-microbial diseases, disease outbreaks and cancer, social issues and vaccines related to microbial diseases.
CO 3	Write about the concept of Infectious and non-infectiousdiseases; Microbial and non-microbial diseases; disease outbreaks, vaccines and its types.
CO 4	Explain about the types of human diseases, microbial diseases and its prevention, disease outbreaks and study of cancer and social issues related to microbial diseases and vaccines.
CO 5	Summarize about Human diseases, microbial diseases, disease outbreak, social issues related to microbial diseases and vaccines.
CO6	Generalize the concept of management of human microbial diseases

B. Sc. (Hons.) Microbiology

Course code	**: MICML -802**
Course Name	**: Management of Human Microbial Diseases**
Semester	**: VIII**

L	T	P	C
2	0	0	2

1.Study of composition and use of important differential media foridentification of bacteria: EMBAgar, McConkey agar, Mannitolsalt agar, Deoxycholate citrate agar, TCBS

2.Study of bacterial flora of skin by swab method

3.Perform antibacterial sensitivity by Kirby-Bauer method

4.Identification of human blood groups.

5.To perform Total Leukocyte Count of the given blood sample.

6.To perform Differential Leukocyte Count of the given bloodsample.

7.To separate serum from the blood sample (demonstration).

8.To perform immunodiffusion by Ouchterlony method.

CO1	Identify and Memorizethe Biosafety guidelines and biosafetylevels.
CO2	Production, monitoring, Estimation of wine.
CO3	Determination the Isolation, biochemicalcharacterization and antimicrobial susceptibility of pathogenic bacteria/fungi /clinical specimens.
CO4	Perform an experiment to determine MIC and MBC concentration of antibiotics by broth dilutiontest.
CO5	Estimate enzyme productionby bacterial and fungal cultures.
CO6	Formulation of media for enzyme production by microbial cultures.

B. Sc. (Hons.) Microbiology

Course code	**: MICME -803a**
Course Name	**:NURSING AND GARDENING**
Semester	**: VIII**

L	T	P	C
4	0	0	4

CourseObjectives:Theobjectivesofthiscourseare

1. Togainknowledge of gardening,cultivation,multiplication,raisingofseedlingsofor nameplants.
2. Hownurseryoftheplantsisprepared.
3. Howrootingispromotedinthestemcuttings.
4. Howseedsarestoredandwhatarethesoilconditionsforseedsowingandseedlinggr owth.
5. Howlandscapingisdesigned.

CourseContent

TOTALHOURS:60 **CREDITS:04**

No.ofHours:10

Unit1: Nursery:definition,objectivesandscopeandbuildingupofinfrastructurefo rnursery,planningandseasonalactivities-Planting-directseedingandtransplants.

No.ofHours:16

Unit2:Seed:Structureandtypes-Seeddormancy;causesandmethodbreakingdormancy -
Seedstorage:Seedbanks,factorsaffectingseedviability,geneticerosionSeedprod uctiontechnology-seedtesting andcertification.

No.ofHours:16

Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season,treatment of cutting, rooting medium and planting of cuttings -Hardeningof plants – greenhouse-mistchamber,shedroot,shadehouseandglasshouse

.No.ofHours:10

Unit 4: Gardening: definition, objectives and scope - different types of gardeninglandscapeandhomegardening-parksanditscomponents-plantmaterialsanddesign-computerapplicationinlandscapingGardeningoperations:soillaying,manuring, watering,managementofpestsanddiseasesand harvesting.

No.ofHours:08

Unit5:Sowing/raisingofseedsandseedlings-Transplantingofseedlings-Studyofcultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, andcarrots-Storageandmarketinprocedures.

Textbooks

TB1.BoseT.K.&Mukherjee,D.,1972,GardeninginIndia,Oxford&IBHPublishingCo.,NewDelhi.

TB-2 Sandhu,M.K.,1989,PlantPropagation,WileEasternLtd.,Bangalore,Madras.

TB-3 Kumar,N.,1997,IntroductiontoHorticulture,RajalakshmiPublications,Nagercoil.

ReferenceBook

RB1-
EdmondMusser&Andres,FundamentalsofHorticulture,McGrawHillBookCo,NewDelhi.

RB2-
Agrawal,P.K.1993,HandBookofSeedTechnology,Dept.ofAgriculturea2ndCooperation,National_SeedCorporationLtd.,NewDelhi.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Define the terminology used in Nursery, seed ,vegetative propagation and gardening.
CO 2	Discuss about objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants, Seed –Structure, types, and storage and production technology, Vegetative propagation and gardening.
CO 3	Explain about nursery and planting, seed, vegetative propagation and its types and gardening.
CO 4	Explain and differentiate between nursery and gardening, planting, seed , vegetative propagation and its types.
CO 5	Summarize the concept of nursery and gardening
CO6	Revise about Nursery, seed ,vegetative propagation and gardening.

B. Sc. (Hons.) Microbiology

Course code	**: MICML -803a**
Course Name	**:Lab course based on MICMC803a**
Semester	**: VIII**

L	T	P	C
2	0	0	2

1. Togainknowledgeofgardening,cultivation,multiplication,raisingofseedlingsofor ornamentalplants.
2. Hownurseryoftheplantisprepared.
3. Howrootingispromote the stemcuttings.
4. Howseedarestoredandwhatarethesoilconditionsfor seedsowing and seedlinggrowth.
5. Howlandsdesigned.

Uponsuccessfulcompletionofthecourseastudentwillbeableto

CO 1	Togainknowledgeofgardening, cultivation, multiplication,raisingofseedlingsofornamentalplants
CO 2	Study of preparation of Nursery for plant growth.
CO 3	Study of root cutting
CO 4	Study of cultivation of plant in Nuresry.
CO 5	Study of applying method of extra nutrients in plant.
CO6	Study of storage of plant in various environmental condition.

B. Sc. (Hons.) Microbiology

Course code	**: MICME-803b**
Course Name	**:Biomaths, Biostats, Computer Programming & Application**
Semester	**: VIII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To learn to define and find the solution of arithmetic mean, median and mode, Quartiles, deciles and percentiles.
2. To demonstrate knowledge of chi square test, t-test, distributions, correlation and regression.
3. To develop the concepts of moments, skewness and kurtosis and determining whether the given distribution is normal or not.
4. To understand and illustrate the theory and applications of the probability.
5. To demonstrate computer programming and components of a computer system.

Unit 1 No. of Lecture - 13

Relation of Life Science with mathematics, Linear function concept, 0.5 coordinate system, trigonometry relations, differentiation & integration concept, logarithms, complex numbers, Plotting of graphs, matrices.

Unit 2No. of Lecture -18

Importance of statistics in biomedical research. Mean, Mode, median, range, mean deviation, standard deviation, standard error, skewness & kurtosis. Correlation & Regression. Probability: Theorems, Addition rules, multiplication rules, probability applications, probability distributions- Binomial, Poisson & Normal Distributions.

Unit 3No. of Lecture -17

Chi square test-characteristics of Chi square test, validity of Chi square test, applications of Chi square test. Test for significance- comparison of means of two samples, comparison of means of three or more samples (f-test, t-test).

Unit 4No. of Lecture -12

Need for computer language, reading C Programs, Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units).Data storage

device, Memory concepts.Software and types of software.Applications of common packages, Microsoft Office: Microsoft word, Microsoft excel, Microsoft Power Point.

Suggested Reading and Text Books

1. Rajaraman V: Computer Programming in "C". PHI.
2. Yashwant Kanetker: Let us "C" BPB.
3. Peter Norton's: Introduction to Computer.
4. Hoel, P.G: Elementary Statistics John Wiley & Sons, Inc. New York.
5. Mahajan: Methods in Biostatistics (4thed.) Jaypee Bros. 1984.
6. Sokal&Rohlf: Introduction to Biostatistics, Freeman, Toppan, 1993.
7. D. Rajaraman & V. Rajaraman: Computer primer (2nded.) Prentice Hall of India, New Delhi.
8. Roger Hunt & John Shelley: Computer and Commonsense Prentice Hall of India, New Delhi.
9. Norton, Peter: Introduction to Computers (2nd ed.), TMH Publishing Company Ltd., New Delhi.

B. Sc. (Hons.) Microbiology

Course code	**: MICML-803b**
Course Name	**:Biomaths, Biostats, Computer Programming & Application**
Semester	**: VIII**

L	T	P	C
2	0	0	2

CourseObjectives:Theobjectivesofthislabcourseare

1. **Learn calculationofcentraltendencies, standard deviation andcoefficientofvariation.**
2. **Understandskewnessandkurtosisandcurvefitting.**

TOTALHOURS:60CREDITS:02

1. Mean,medianandmodefromgroupedandungroupeddataset.
2. StandarddeviationandCoefficientofvariation.
3. SkewnessandKurtosis.
4. Curvefitting.
5. CorrelationandRegression.
6. Findingareaunderthecurveusingnormalprobability.
7. Testingofhypothesis-Normaldistribution,t-testandChi-Square-test.
8. Confidenceinterval.

Uponsuccessfulcompletionofthelabcourseastudentwillbeableto

CO 1	Describe calculation of central tendencies, standard deviation and coefficient of variation and computer language.
CO 2	Discuss mean, median and mode from grouped and ungrouped data set and Components of a computer system.
CO 3	Develop skewness and kurtosis, curve fitting , Components of a computer system
CO 4	Differentiate correlation and regression.
CO 5	Compare confidence interval and Components of a computer system.
CO6	Express hypothesis test- normal distribution, t-test and chi-square test and types of computer.

B. Sc. (Hons.) MICROBIOLOGY

Course code	**: MICOE-804**
Course Name	**:MOLECULAR VIROLOGY AND INFECTION-II**
Semester	**: VIII**

L	T	P	C
2	0	0	2

Course Objectives: The objectives of this course are

1. To learn about morphology Plant and animal viruses.
2. To gain knowledge about PCR Techniques.
3. To learn about Interferon.

UNIT-1 Cultivation of Viruses and Viral Vaccines : Cultivation of viruses in embryonated egg, tissueculture and laboratory animals. Conventional vaccines- Killed and attenuated. Modern vaccines- Recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators

(cytokines). Vaccine delivery and adjuvants, large-scale manufacturing. COVID Vaccine.

UNIT – II **No. of Hours : 12**

Virological Methods: Method of for purification of viruses with special emphasis on ultracentrifugation methods. Quantitative diagnostic methods- Haemagglutination, complement fixation, neutralization, Western blot, flow cytometry. Nucleic acid based diagnosis PCR, microarray and nucleotide sequencing. Application of Microscopic techniques Fluorescence, confocal and electron microscopic techniques. Diagnosis method of corona virus.

Text Books:

1. Rothman, K.J. and Greenland, S. Modern epidemiology. Lippincott-Raven, Philadelphia.
2. Dockrell, H., Zuckerman, M., Roitt, I.M. and Chiodini, P.L. Mim'smedical microbiology. Elsevier, London
3. Gordis, L. Epidemiology. Saunders, Philadelphia.
4. Anderson, R.M. and May, R.M. Infectious diseases of humans: Dynamics and control. Oxford University Press, Oxford

.**Reference Books**

1. Giesecke, J. Modern infectious disease epidemiology. Edward Arnold, London
2. Clayton, D. and Hills, M. Statistical models in epidemiology. Oxford University Press, Oxford.
3. Rothman K.J., Greenland, S. and Lash, T.L. Modern epidemiology. Lippincott William sand Wilkins, Philadelphia

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Learn about molecular basis of viral infection.
CO2	Discuss about history, cultivation,replication and virological method of viruses.
CO3	Write about viruses structure, replication, cultivation and antiviral agent.
CO4	Explain the viral infection,cultivation,antiviral agent and VirologicalMethods.
CO5	Summarize the steps of viruselife cycle with reference to antiviral agent .
CO6	Compilethe infection of viruses and Molecular diagnostic tools used in detection of viral infection.

B. Sc. (Hons.) Microbiology

Course code	**:MICVO-805**
Course Name	**:Bio- Entrepreneurship**
Semester	**: VIII**

L	T	P	C
3	0	0	3

Course Objectives: The objectives of this course are

1. TounderstandthemeaningandimportanceofEntrepreneurship.
2. Tounderstandthevariousformsoil businessorganization.
3. Toanalyzetheimportanceoffinenterprise.
4. Toanalyzetheimportanceofmarketingmanagementinanenterprise.
5. Tounderstandthemeaningofinternationalbusiness.

Unit 1 No . of Lecture-14

Starting a venture; Assessment of feasibility of a given venture/ new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/ Plan for seeking loans from financial institution & Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management.

Unit 2No . of Lecture-18

Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping. Estimation of income, expenditure, profit.Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes.

Unit 3No . of Lecture-18

Services Marketing Negotiations/Strategy with financiers, bankers, Government/ law enforcement authorities; with companies/Institutions for technology transfer; Dispute resolution skills. Human Resource Development (HRD): Leadership skills; Managerial skills.

Role of knowledge centre and R&D. Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies. Case Studies.

Suggested Reading and Text Books

1. Handbook of Bioentrepreneurship Vol 4. by Holger Patzelt& Thomas Brenner (ed) Springer(2008)
2. Handbook of Entrepreneurship Research, 2005. Zoltan J. Acs and David B. Audretsch (eds.)

3. Handbook of Entrepreneurship Research: Interdisciplinary Perspectives, 2005. Sharon A. Alvarez, Rajshree Agarwal, and Olav Sorenson (eds.):
4. The Life Cycle of Entrepreneurship Ventures, 2005.Simon Parker (ed.)
5. Handbook of Bioentrepreneirship, Holger Patzelt and Thomas Brenner (eds.)

CourseOutcomes(COs): Oncompletionofthiscourse,thestudentswillbe:

CO	Description
CO1	Define the terms and basic concepts of entrepreneurship development and their different roles to influencing entrepreneurship, features of a successful Entrepreneurship
CO2	Explain the introduction and principle, mechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.
CO3	Explain the detailed of processesofmechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.
CO4	Explain Biotechnological entrepreneurship features for the growth or individual person and society
CO5	Summarize the properties of mechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.
CO6	Create the entrepreneurship and the awareness, appreciation and applicabilityinenvironment,and their diverse functions.

Degree Course in Microbiology with Research

B. Sc. Microbiology with Research

Course code	**: MICMC- 701**
Course Name	**:Research Methodology**
Semester	**: VII**

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To introduce with meaning, functions of research and research process.
2. To highlights the various postulates of research problems, research Design, interpretation and report writing.
3. To expose the student to concepts of measure of central tendency and variation and their application to analyze the statistical data.
4. To acquire the knowledge of correlation, regression, data analysis and hypothesis testing using suitable test of statistical significance.

UNIT-I: Meaning &Functions of Research (Total Topics- 12 and Hrs.-10)

Meaning of Research, Characteristics of Research, Steps involved in Research, Research in Pure and Applied Sciences, Inter Disciplinary Research, Trans disciplinary research, Significance of Research, Research and scientific methods, Research Process, Criteria of good Research, Problems encountered by Researchers, Literature review.

UNIT –II: Research Problem and Research Design(Total Topics -09 and Hrs-10)

Selecting the Research problem, Necessity of defining the problem, Goals and Criteria for identifying problems for research, Perception of Research problem, Formulation of Research design, Need for

Research design, Features of good design, Basic principles of experimental designs, Computer and internet in designs.

UNIT- III: Interpretation and Report Writing (Total Topics -08 and Hrs-10)

Meaning and Technique of interpretation, Precautions in interpretation, Significance of report writing, Different steps in writing a report, Layout of a Research report, Types of report, Mechanics of writing a research report, Precautions for writing a research report

UNIT-IV: Statistical Techniques and Tools -I (Total Topics -10 and Hrs-10)

Introduction of statistics, frequency distribution, Graphical representation of data, Measures of central tendency, Mean, Median, Mode, Standard deviation, Co-efficient of variation, Probability & distribution

UNIT-V: Statistical Techniques and Tools –II(Total Topics -12 and Hrs-12)

Correlation, coefficient of correlation, Scatter diagram, Regression, Sampling distribution, Standard error, Hypothesis testing, Level of significance, Degree of freedom, Chi Square, T-test, Analysis of variance (ANOVA)

Suggested readings:

1. KothariC.R.,Research Methodology Methods &Techniques,New Age international Publishers.
2. GuptaG. and GuptaM., Research Methodology, PHI Learning Private Ltd.
3. GuptaS.C. and Kapoor V.K., Fundamentals of Mathematical statistics, , Sultan Chand & Sons, New Delhi.

Course Outcome

CO1.	Define various kind of research, objectives of doing research, researchprocess and research design.
CO2.	Discuss the ability to choose methods appropriate to research aims and objectives.
CO3.	Explain analyze data and draw reasonable interpretations as well as communicate research findings in a clear and well-organized way.
CO4.	**Explain** Statistical tools and techniques to carry out data analysis and hypothesis testing using suitable test of statistical significance.
CO5.	**Summarize the** properties of mechanism of research methodology
CO6.	**Create a** research methodology

B. Sc. Microbiology with Research

Course code : MICMC- 702
Course Name :Research Publication and Ethics
Semester : VII

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

Its objectives to provide knowledge about quality and ethics publication with concept of plagiarism.

UNIT-I: Meaning &Functions of Research No of Lecture-12

Philosophy: Definition, introduction of concept, branches of Philosophy, Introduction of Metaphysics, Epistemology, Ethics/ Moral, Political and Aesthetics Philosophy

Moral philosophy, nature of moral judgments and reactions.

UNIT –II: Research Problem and Research DesignNo of Lecture-14

Ethics: Definition with respect to science and research, Intellectual honesty and research integrity

Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

UNIT- III: Interpretation and Report Writing No of Lecture-12

Publication ethics: Definition, introduction and importance, Best practices/ standards setting initiatives and guidelines: COPE, WAME,etc., Conflicts of interest, Publication misconduct: Definition, concept, Introduction about authorship and contributorship, Violation of Publication Ethics, Identification of publication, complaints and appeals

UNIT-IV: Statistical Techniques and Tools -INo of Lecture-12

Introduction about Journals & Publishers, Predatory publishers and journals, Quality of Journals & Publication, Introduction about Scopus/SCI,eSCI/Web of Science Indexing (Scopus.com) etc., Software tool to identify predatory publications developed by SPPU Plagiarism tools , Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester, etc.

Suggested readings:

1. Dutta, Sumanta, Research and Publication Ethics, Bharti Publications.
2. Yadav S.K., Research and Publication Ethics, Anne Publications.

Course Outcome

CO1.	Define basics of philosophy of science with research ethics.
CO2.	Discuss about the important issues in research ethics, integrity & scientific misconduct.
CO3.	Explain for publications, publication ethics and identify the predatory publishers & journals.
CO4.	**Explain** study related totheuse plagiarism software tools, citation databases and research metrics.
CO5.	**Summarize the** properties of mechanism of Research Publication and Ethics.
CO6.	**Create** the Research Publication and Ethics.

B. Sc. Microbiology with Research

Course code	**: MICRM- 703**
Course Name	**: Review of literature/ Minor Project**
Semester	**: VII**

L	T	P	C
0	0	0	10

Course Objectives: The objectives of this course are

1. The intention of this course is to expose the student to new dimensions of research & development.
2. The course enhances different aspects of scientific reading and writing.
3. The course also ensures the student to learn practical based scientific skills.

In the beginning of 4th year (7th semester), students are required to undertake review of literature as a part of their minor project. Its progress will be assessed at the end of 7th semester. Title of the project work may be extended in the 8th semester as a major project. At the end of the 8th semester the dissertation is to be submitted in the department. If a student opts to carry out his/her project (major/minor) from industry or research organization/Institute then he/she may be allowed for the same but the dissertation copy is to be submitted in the department and the internal supervisor will be required from the university

Suggested readings:

3. Dutta, Sumanta, Research and Publication Ethics, Bharti Publications.
4. Yadav S.K., Research and Publication Ethics, Anne Publications.

Course Outcome.

CO1.	Define the Enhance his/her presentation skills in a creative manner
CO2.	Discuss about Enhancing thinking skills and create innovative new products
CO3.	Explain and develop qualities like perseverance, curiosity and self-confidence
CO4.	Explain**the s**tudy related tograde up their problem-solving ability
CO5.	Summarize the properties of mechanism of Review of literature/ Minor Project.
CO6.	Create aReview of literature/ Minor Project.

B. Sc. (Hons.) Microbiology

Course code	**: MICRS 704**
Course Name	**: Research Seminar Presentation-I**
Semester	**: VII**

L	T	P	C
0	0	0	5

Course Objectives: The objectives of this course are

1. To demonstrate technical skills for effective preparation of presentations, write-ups through participant in academic and extracurricular activities.
2. To exhibit good communication and presentation skills.
3. To acquire critical thinking ability to analyze and interpret observations, recent scientific developments, etc.

Each student has to participate in any one of the following mentioned academic activity. A power point presentation will be presented by each student pertaining to the activity in which the student has participated. A hard copy of the presentation will be submitted in the department. Evaluation will be done based upon the presentation and report submitted.
Activities:

(i) Participation in seminar / conference / workshop

Poster presentation/ oral presentation in any other academic event (beside seminar / conference) organized by departmental clubs / College / University / research institute.

Suggested Readings: NA

Course Outcome.

CO1.	Demonstrate technical skills for effective preparation of presentations, write-ups through participant in academic and extracurricular activities
CO2.	Exhibit good communication and presentation skills
CO3.	Acquire critical thinking ability to analyze and interpret observations, recent scientific developments, etc
CO4.	Analyzethedetailed and complete study related to Research Seminar Presentation.
CO5.	Summarize the properties of mechanism of Research Seminar Presentation.
CO6.	Create the Research Seminar Presentation.

B. Sc. (Hons.) Microbiology

Course code : MICRR-801
Course Name :Research-IPR
Semester : VIII

L	T	P	C
4	0	0	4

Course Objectives: The objectives of this course are

1. To explain about Intellectual Property and Copyrights
2. To explain about software patents and their importance.
3. To gain knowledge about trade marks
4. To layout design of integrated circuits and Industrial Designs
5. To Illustrate layout design and Different International Agreements

UNIT-I:

Introduction to Intellectual Property: Historical Perspective, Different Types of IP, Importance of protecting IP.

Copyrights: Introduction, how to obtain, Differences from Patents.

UNIT –II:

Trade Marks: Introduction, how to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.

Patents: Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

UNIT- III:

Geographical Indications: Definition, rules for registration, prevention of illegal exploitation, importance to India.

Industrial Designs: Definition, how to obtain, features, international design registration.

Layout design of integrated circuits: Circuit Boards, Integrated Chips, Importance for electronic industry.

UNIT-IV:

Trade Secrets: Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.Word Trade Organization (WTO): (i) General Agreement on

Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement (ii) General Agreement on Trade related Services (GATS), (iii) Madrid Protocol (iv) Berne Convention, (v) Budapest Treaty (b) Paris Convention WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity IP Infringement issue and enforcement-Role of Judiciary, Role of law enforcement Agencies-Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Suggested Readings:

1. Acharya, N.K.: Textbook on intellectual property rights, Asia Law House.
2. Guru, M,&Rao, M.B., Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications.
3. Ganguli, P., Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill.
4. Miller,A, R,MichealH.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers.
5. Watal, J., Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford

Course Outcome:

CO1.	Acquire knowledge about Intellectual property rights, copyrights, trademarks and patents.
CO2.	Appraise about geographical indications, industrial designs, trade secrets and different international agreements including Paris convention, Budapest treaty etc
CO3.	Analyse layout designs of integrated circuits, risks involved in trade secret protection, international design registration, rules for registration of geographical indications etc.
CO4.	Anaylzeto Research-IPR.Assess introduction and historical perspectives of trade secrets, working of WTO, Madrid protocol, different type of IPs, trademarks, copyrights etc.
CO5.	Summarizethe properties of mechanism of Research-IPR.
CO6.	Create theResearch-IPR.

B. Sc. (Hons.) Microbiology

Course code	**: MICMP 802**
Course Name	**: Major Project/ Internship**
Semester	**: VIII**

L	T	P	C
0	0	0	14

Course Objectives: The objectives of this course are

7. To make the students industry deployable.
8. To provide an opportunity to students to gain practical knowledge.
9. To provide an opportunity to pursue higher education in reputed organization across the globe.

Every student must enroll for project/dissertation under the guidance of faculty member/supervisor from industry/research organizations. Students will have to submit project work and will be evaluated at the end of the semester followed by presentation and viva. The thesis will be evaluated internally by a panel of examiner.

Suggested Readings: NA

Course Outcome:

CO1.	Demonstrate analytical and practical training.
CO2.	Interpretation and organization of data
CO3.	Develop thesis writing skills.
CO4.	Anaylzethestudy related to Major Project/ Internship.
CO5.	Summarize the properties of mechanism of Major Project/ Internship.
CO6.	Create the Major Project/ Internship.

B. Sc. (Hons.) Microbiology

Course code	**: MICRS 803**
Course Name	**: Research Seminar Presentation-II**
Semester	**: VIII**

L	T	P	C
0	0	0	5

Course Objectives: The objectives of this course are:

1. To demonstrate technical skills for effective preparation of presentations, write-ups through participant in academic and extracurricular activities.
2. To exhibit good communication and presentation skills.
3. To acquire critical thinking ability to analyze and interpret observations, recent scientific developments, etc.

Each student has to participate in any one of the following mentioned academic activity. A power point presentation will be presented by each student pertaining to the activity in which the student has participated. A hard copy of the presentation will be submitted in the department. Evaluation will be done based upon the presentation and report submitted.

Activities:

(i) Participation in seminar / conference / workshop

(ii) Poster presentation/ oral presentation in any other academic event (beside seminar / conference) organized by departmental clubs / College / University / research institute.

OR

If student opts internship, it is compulsory to complete 4 weeks internship between 7^{th} and 8^{th} semester in any industry/ research institute/ various agencies/ other organizations and to submit internship report in department will be evaluate in department through presentation and internship report.

Suggested Readings: NA

Course Outcome:

CO1.	Demonstrate technical skills for effective preparation of presentations, write-ups through participant in academic and extracurricular activities.
CO2.	Exhibit good communication and presentation skills.
CO3.	Acquire critical thinking ability to analyze and interpret observations, recent scientific developments, etc.
CO4.	Analyze astudy related to Major Project/Research Seminar Presentation.
CO5.	Summarize the properties of mechanism of Major Project/ Major Project/Research Seminar Presentation.

CO6.	Create a Major Project/ Major Project/Research Seminar Presentation.