Manav Rachna International Institute of Research and Studies

(Deemed to be university under section 3 of the UGC Act 1956)

CURRICULUM
AND
SCHEME OF EXAMINATION

B.Sc (H) MICROBIOLOGY

2021-24

Faculty of Engineering & Technology
Department of Biotechnology
Faridabad-121006, Haryana.

FOREWORD

This is to certify that this booklet contains the entire Curriculum and Scheme of Examination of B.Sc (H) Microbiology being offered at Department of Biotechnology, Faculty of Engineering and Technology of this University. This has been duly vetted and finally approved by the Academic Council of the University vide agenda item 40.13.01 of 40th AC held on 10th May, 2022 and changes, if any deemed appropriate, shall be duly incorporated after the necessary approval by the Academic Council.

This Curriculum and Scheme of Examination B.Sc (H) Microbiology shall be implemented w.e.f. AY 2021-22.

Prof. (Dr.) Naresh Grover
Date: **Dean-Academics, MRIIRS**

Preamble

Microbiology domain refers to the study of microscopic organisms, also called microorganisms or microbes which include bacteria, viruses, fungi, algae, cyanobacteria, protozoa and prions. Micro-organisms are ubiquitous and showcase a huge range of diverse activities such as causation of deadly diseases in humans, animals and plants, production of highly useful products like antibiotics, enzymes, alcohol, fermented foods, and recycling of dead and decaying organic matter in the nature. Microorganisms influence almost every aspect of human life such as health, environment, agriculture and industry. This necessitates the study of Microbiology at undergraduate level so that students develop sound understanding of microbiological processes, their importance and utilization for scientific and economic growth.

The Choice Based Credit System (CBCS) curriculum for Microbiology at the undergraduate level has now been developed into a new system called Learning Outcome Curriculum Framework (LOCF) under the recommendations and guidance of University Grants Commission (UGC). The LOCF approach first envisioned the programme learning outcomes of the B.Sc.(Hons) program in Microbiology as well as the learning outcomes of the courses being taught under this programme, keeping in view the graduate attributes of the subject. The curriculum was then developed in tune with the learning outcomes. It is envisaged that the students trained under this curriculum will have the required attributes of knowledge, skills, temperament and ethics related to the subject of Microbiology. Besides the contents of the curriculum, the teaching learning processes have also been designed to achieve these attributes. A variety of learning assessment tasks have been included in the curriculum. Besides assessing the knowledge/skills acquired by the students, these tasks would also help to supplement the teaching learning processes.

The compulsory courses encompass all important aspects of the discipline of Microbiology and are all compulsory courses. The choice based Discipline Specific Elective (DE) courses are designed to enhance the expanse of the subject. DE also give the students a chance to apply their knowledge of microbiology to study societal problems and suggest solutions in the form of small project under the mentorship of their teachers. These are also designed to expose the students to leaders / innovators in the areas related to microbiology for inspiration. A number of Skill based Elective Courses (SEC), 4 Credits each would give the students option to develop skills in areas which have direct relevance to employability in diagnostics, health, food and pharmaceutical industries, agriculture and environment-related job opportunities in Microbiology.

Learning Outcomes based approach to Curriculum Planning:

Learning Outcome based approach to curriculum planning is almost a paradigm shift in the whole gamut of higher education such that it is based on first and foremost identifying the outcomes of the learning required for a particular subject of study, and then planning all components of higher education so as to achieve these outcomes. The learning outcomes are the focal point of the reference to which all planning and evaluation of the end learning is compared and further modifications are made to fully optimize the education of the individuals in a particular subject. For the subject of Microbiology the outcomes are defined in terms of the understanding and knowledge of the students in microbiology and the practical skills the students are required to have to be competitive microbiologist so that they are able to play their role as microbiologist wherever required in the society such as the diseases caused by the

microbes, their diagnosis and remedies; the role of microbiologists in the biotechnology industry and how they may be able to fit the bill in the industry. The students are also trained in such a way that they develop critical thinking and problem solving as related to the microbiology. The curriculum developed and the teaching and the evaluation tasks are such that the students are able to apply their knowledge and training of microbiology to solve the problems of microbiology as these exist or appear from time to time in the society. The curriculum envisions that the student, once graduate as specialists in a discipline, have an important role to play in the newer developments and innovations in the future in the subject for advancement of the discipline.

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DEPARTMENT OF BIOTECHNOLOGY

VISION

Our vision is to produce competent biotechnologists who can employ premium processes and applications which will profoundly influence existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society.

MISSION

- To provide Biotechnology educational program with impetus to generate quality workforce
- To create awareness about potentials of Biotechnology with socio-ethical implications.
- To instill spirit of innovation and creativity in young minds with sound research aptitude.
- To nurture confident individuals who are effective contributors towards growth of the nation.

ABOUT THE DEPARTMENT

The Department of Biotechnology was set up in the year 2002 at ManavRachna campus. The programmesoffered by the department at uder-graduate, post-graduate and doctoral levels areB.TechBiotechnology (4 Years), B.Sc. (H) Microbiology (3 Years), M.TechBiotechnology (2 Years),M.Sc Biotechnology (2 Years), M.Sc Microbiology (2 Years) and PhD in Biotechnology and allied areas. Highly qualified teaching faculty with Doctoral and M.Tech qualifications in different areas of Biotechnology is the highlight of this Department. Faculty members and students of the Department have more than 250 publications in National and International journals of high repute including proceedings of seminars/ conferences.

The Department has a wide range of laboratories namely Cell Biology Lab, Microbiology Lab, Fermentation Technology Lab, Molecular Biology Lab, Environment Biotechnology Lab, Bioinformatics equipped with world class instrument facilities like HPLC, Atomic Absorption Spectroscopy, IR Spectroscopy, Fermenter, Gel Doc System, PCR, etc. A state-of art research level laboratory has been recently established as 'Molecular Biosciences Research Lab'. It is fully equipped with animal cell culture facility and houses major instruments like CO_2 incubator, fluorescence microscope, deep freezer, fume hood etc. This laboratory is meant for advanced research in molecular biology, animal biotechnology, enzyme technology and other allied areas. B.Tech Biotechnology offered by Department of Biotechnology has been accredited by NBA

Department of Biotechnology has MoUs with industry and premium research organizations of India to facilitate academics and research and reinforce an environment of knowledge sharing and dissemination. The focus of these collaborations is to facilitate students and faculty in R&D, joint projects, trainings, utilizing high end instrumentation facilities. These organizations are-

1. Translational Health Science and Technology Institute (THSTI), Faridabad
2. ICAR-National Bureau of Plant Genetic Resources (NBPGR), New Delhi
3. National Institute of Immunology (NII), New Delhi
4. Indian Institute of Petroleum (IIP) Dehradun
5. Indian Oil Company Ltd. (IOCL), Faridabad
6. AdvanCells- Stem Cell Therapy, Noida

One of the biggest achievements of the Department of Biotechnology is the Startup Company- "TRICHO AGRONICA Pvt. Ltd. The Department of Biotechnology has developed a bioformulation 'Bioelixir' which is a completely organic remedy for Bull's eye pathogen causing early blight disease in tomato (*Lycopersiconesculentum* Mill.) crop. This Startup has been setup under Indian oil start up scheme (IOSUS), a "Start-up India" initiative and has been granted a funding of Rs.1.72 Crores.

The immense potential for placements in Biotechnology is evident from the success stories of alumni of the department. The pass out students of Biotech have bagged excellent placements in leading companies, viz, Agilent Technology, Covedien, Imperial Life Sciences, LifeCell International, Totipotent RX, Sagacious Research, CHC Health Care, e4e Health Group, Link Biotech, Ozone Biotech, CPM, Panacea Biotech, Medox Diagnostics, TCS (Biotech Division), Infosys (Biotech Division), IDS, L&T Infotech, IFBI and HCL, SCOTT EDIL & Kelly Services India Pvt. Ltd, Boston Scientific, etc.

Many pass outs have opted for higher studies in both national and International universities after qualifying in competitive exams. National institutes include IIT- Delhi, IIT- Kharagpur, IIT, Kanpur, IIT, Guwahati, NIT, Surthkal, NIT- Kurukshetra, VIT, Vellore, BITS- Pilani, BHU, Banaras and Anna University, Chennai etc. International institutions where the alumni of Biotech have pursued their higher education are University of Minnesota, USA, University of Buffalo, USA, University of Pennsylvania, USA, John Hopkins, USA, Nottingham Trent, UK, Sydney University, Australia, Arizona State Univ, USA, Baltimore Univ, USA, Florida Inst Of Tech, USA, WorcestorPolytech, USA, Imperial College - London, Monash Univ. Australia, University of Kuopio, Finland etc.

And the journey continues…

B.Sc. (H) IN MICROBIOLOGY

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

1. To make our students competent in the domain of Microbiology.

2. To inculcate the skills related to handling of microbes, biosafety and good microbiological practices.

3. To equip the students with strong ethics and communication skills to pursuehigher education and research in reputed institutes at national and international level.

4. To develop the capability to innovate, generate new knowledge, enterprise and build a successful career.

PROGRAMME OUTCOMES (PO)

1. Acquire knowledge and understanding of the microbiology conceptsas applicable to diverse areas such as medical, industrial, environment,genetics, agriculture, food and others.

2. Develop competence to use microbiology knowledge and skills toanalyze problems involving microbes, articulate these with peers/ teammembers/ other stake holders, and undertake remedial measures/ studies etc.

3. Evolve a broader perspective of the discipline of Microbiology in order to identify challenging societal problems and plan theprofessional career to develop innovative solutions for such problems with ethical attitude, team spirit and leadership qualities.

4. Aptitude to apply knowledge and skills that are necessary to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSO)

1. Acquire knowledge of fundamentals of Microbiology for sound and solid base which enables to understand the emerging and advanced concepts in this domain.

2. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside,including the use of good microbiological practices

3. Empower the students to acquire technologicalknowhow by connecting disciplinary and interdisciplinary aspects of microbiology enabling them to pursue higher education and research in reputed institutes at national and international level.

MAPPING OF PEO WITH PO AND PSO

PEOs	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 3
1	3	3	3	3	3	3	3
2	3	3	2	2	3	3	3
3	2	2	3	3	2	3	3
4	3	3	3	3	2	3	3

B.Sc (H) IN MICROBIOLOGY

SEMESTER SYSTEM AND CHOICE BASED CREDIT SYSTEM

Credit based system of study and student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grade obtained by the student, grade point average is calculated –

(a) Course credits assignment
Each course has a certain number of credits assigned to it depending upon its duration in periods for lecture, tutorial and laboratory practice in a week.
(b) Earning of credits
At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however shall be mandatory to pass as a partial fulfillment of award of degree.
For Award of Degree of a programme B.Sc. (H) in Microbiology, he/she has to earn minimum 140 **Credits** during the **3 year duration** of the programme in **6 semesters**.

The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket", and "Elective Courses Basket". The **total 108 credits** required to be earned under "Compulsory Courses Basket" and **32 credits** under "Elective Courses Basket".

All courses under "Compulsory Courses Basket", are required to be qualified and cleared/pass by each and every students enrolled under the programme and are semester-wise listed in the study scheme along with credits assigned to each course.
Under Elective Courses Basket, there will be three types of courses:

- Semester-wise courses offered by the department itself
- Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.
- Massive Open Online Courses (MOOCs) available on SWAYAM Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. Student shall be required to register courses every semester for as many courses/credits specified under "Elective Courses Basket" depending upon his/her interest, capability/pace of learning and availability of time slot (without any clash in time table) so as to earn all required total credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses [including courses under "Compulsory Courses Basket", "Elective Courses Basket" and Previous Semester Courses (wherein he/she was declared in-eligible on the basis of attendance or he/she could not clear the course within permissible given chances)], if any, the maximum limit in a semester shall be 30 credits.

STUDY SCHEME

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

B.Sc(H) - Microbiology

SEMESTER- I

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous Assessment	End Sem Assessment	Total		
Core	BMB-DS-101	Microbial World and Principles of Microbiology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-102	Bacteriology and Systematics	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-103	Cell Biology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-151	Basic Microbiology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-152	Bacteriology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-153	Cell Biology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
HSMC	BHM-201	English	2	0	0	2	50	50	100	3 hrs.	2
		Total	**14**	**0**	**9**	**23**	**500**	**500**	**1000**		**18.5**
Discipline Specific Elective Courses											
DSE	BMB-DS-121	Hereditary and Evolution	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-154	Hereditary and Evolution Lab	0	0	3	3	50	50	100	3 hrs.	1.5
DSE	BMB-DS-122	Microbial Technology	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-155	Microbial Technology Lab	**0**	**0**	**3**	**3**	50	50	100	3 hrs.	**1.5**

SEMESTER-II

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous	End Sem Assessme	Total		
Core	BMB-DS-201	Biomolecules	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-202	Microbial Techniques & Instruments	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-203	Food and Dairy Microbiology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-251	Biomolecules Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-252	Basic Instrumentation Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-253	Food and Dairy Microbiology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
HSMC	CH-202 B	Environmental Studies	3	0	0	3	100	100	200	2 hrs.	3
		Total	**15**	**0**	**9**	**24**	**550**	**550**	**1100**		**19.5**
Discipline Specific Elective Courses											
DSE	BMB-DS-221	Bioinformatics	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-254	Bioinformatics Lab	0	0	3	3	50	50	100	3 hrs.	1.5
DSE	BMB-DS-222	Soil Microbiology	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-255	Soil Microbiology Lab	0	0	3	3	100	50	100	3 hrs.	1.5

Under elective courses, besides the mentioned domain specific elective courses other inter-disciplinary, generic, online courses (MOOCs, etc) and other approved courses shall be offered which shall be notified well before start of the session. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credit in a semester and for the category of elective courses under University rules.

01 extra credit for Field Visits. The breakup of total 50 internal marks includes 20 marks for sessional tests, 5 marks for attendance and remaining 25 marks for Field Work & Report Writing / Model Making.

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DEPARTMENT OF BIOTECHNOLOGY

B.Sc(H) - Microbiology

SEMESTER-III

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous Assessment	End Sem Assessment	Total		
Core	BMB-DS-301	Virology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-302	Mycology & Phycology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-303	Environmental Microbiology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-351	Mycology & Phycology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-352	Environmental Microbiology Lab	0	0	2	2	50	50	100	3 hrs.	1.5
HSMC	DTI-300	Design, Thinking and Innovation – III	1	0	0	1	50		50		1
HSMC	BHM-MC-004	Quantitative Aptitude	0	0	2	2	50	50	100	2hr	AP
		Total	**13**	**0**	**7**	**20**	**500**	**450**	**950**		**16**
Discipline Specific Elective Courses											
DSE	BMB-DS-321	Plant Pathology & Disease Management	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-353	Plant Pathology & Disease Management Lab	0	0	3	3	50	50	100	3 hrs.	1.5
DSE	BMB-DS-322	Pharmaceutical Microbiology	4	0	0	4	100	100	200	3 hrs.	4
DSE	BMB-DS-354	Pharmaceutical Microbiology Lab	0	0	3	3	50	50	100	3 hrs.	1.5

SEMESTER-IV

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Continuous	End Sem Assessmen	Total		
Core	BMB-DS-401	Molecular Biology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-402	Microbial Genetics	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-403	Industrial Microbiology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-451	Molecular Biology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-452	Industrial Microbiology Lab	0	0	2	2	50	50	100	3 hrs.	1.5
HSMC	DTI-400	Design, Thinking and Innovation – II	1	0	0	1	50		50		1
HSMC	BHM-MC-006	Quantitative Aptitude & Personality Development I	2	0	0	2	50	50	100	2 hrs.	AP
		Total	**15**	**0**	**5**	**20**	**500**	**450**	**950**		**16**
Discipline Specific Elective Courses											
DSE	BMB-DS-421	Advanced Instrumentation: Principles and Applications	4	0	0	4	100	100	200	3 hrs.	3
DSE	BMB-DS-453	Advanced Instrumentation Lab	0	0	2	2	50	50	100	3 hrs.	1.5
DSE	BMB-DS-422	Veterinary Microbiology	4	0	0	4	100	100	200	3 hrs.	3
DSE	BMB-DS-454	Veterinary Microbiology Lab	0	0	2	2	50	50	100	3 hrs.	1.5

Under elective courses, besides the mentioned domain specific elective courses other inter-disciplinary, generic, online courses (MOOCs, etc) and other approved courses shall be offered which shall be notified well before start of the session. The student shall be required and allowed to opt the courses out of offered courses as per prescribed limit for maximum credit in a semester and for the category of elective courses under University rules.

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

B.Sc(H) - Microbiology

SEMESTER-V

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Int	Ext	Total		
Core	BMB-DS-501	Microbial Physiology and Metabolism	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-502	Medical Microbiology and Immunology	4	0	0	4	100	100	200	3 hrs.	4
SEC		SEC-I	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-551	Medical Microbiology and Immunology Lab	0	0	3	3	50	50	100	3 hrs.	1.5
Core	BMB-DS-552	Microbial Physiology Lab	0	0	2	2	50	50	100	3 hrs.	1.5
HSMC	DTI-500	Design, Thinking and Innovation – III	2	0	0	2	50		100	2	2
		Total	**14**	**0**	**5**	**19**	**450**	**400**	**900**		**17**
Skill Enhancement Courses											
SEC	BMB-DS-503	Microbial Quality Control in Food & Pharmaceutical Industries	4	0	0	4	100	100	200	3 hrs.	4
SEC	BMB-DS-504	Microbial Diagnostics and Public Health									
SEC	BMB-DS-505	Human Microbial Disease Management									
SEC	BMB-DS-506	Mushroom Cultivation Technology									

SEMESTER-VI

Compulsory Courses

Course Type	Course Code	Title of Course	Periods/Week				Marks			Duration of Exam	Credits
			L	T	P	Total	Int	Ext	Total		
Core	BMB-DS-601	Recombinant DNA Technology	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-602	Biosafety and Intellectual Property Rights	4	0	0	4	100	100	200	3 hrs.	4
Core		SEC-II	4	0	0	4	100	100	200	3 hrs.	4
Core	BMB-DS-651	Recombinant DNA Technology Lab	0	0	4	4	50	50	100	3 hrs.	2
Core	BMB-DS-652	Biosafety and IPR Lab	0	0	2	2	100	50	100	3 hrs.	1
PROJ	PROJ-MB-600	Project Work	0	0	12	12	200	100	300	3 hrs.	6
		Total	**40**	**0**	**28**	**68**	**1550**	**1300**	**2900**		**21**
Skill Enhancement Courses											
SEC	BMB-DS-603	Food Fermentation Technology	4	0	0	4	100	100	200	3 hrs.	4
SEC	BMB-DS-604	Microbial Products (e. g. Antibiotics, Bio-fertilizers, Biofuels, Bio-pesticides,Vaccines etc.)									
SEC	BMB-DS-605	Microbiological Analysis of Air, Water & Soil									
SEC	BMB-DS-606	Interactions with Entrepreneurs in Microbial Biotechnology and Startups									

Semester	Credits
Sem-1	18.5
Sem-2	19.5
Sem-3	16
Sem-4	16
Sem-5	17
Sem-6	21
Total	**108**

SEMESTER-I

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-101: MICROBIAL WORLD AND PRINCIPLES OF MICROBIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course learning outcomes: The students are able to -

BMB-DS-101.1 develop knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
BMB-DS-101.2 understand the characteristics and importance of different types of microorganisms, methods to organize/classify them.
BMB-DS-101.3 assimilate the general concept of phytoplanktons and zooplanktons.
BMB-DS-101.4 explain the theoretical basis of the tools, technologies and methods common to microbiology and able to assess the economic importance of Mos

.

Unit 1- History of microbiology and introduction to the microbial world

1.1 Germ theory of disease,
1.2 Development of various microbiological techniques and golden era of microbiology.
1.3 Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N.Winogradsky,Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff and Edward Jenner

Unit 2 Classification and Characteristics of microorganisms

2.1 Baltimore classification. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.
2.2 General characteristics of Cellular microorganisms,
2.3 Wall-less forms - MLO (mycoplasma and spheroplasts) with emphasis on distribution and occurrence,morphology, mode of reproduction and economic importance

Unit 3 General concept of phytoplanktons and zooplanktons.

3.1 General characteristics, structure, mode of reproduction and economic importance of actinomycetes and algae with special reference to its application in medicine and industry.
3.2 General characteristics, occurrence, structure, reproduction and importance of protozoa.

Unit 4 Methods of studying microorganism and their importance

4.1Staining techniques: simple staining, Gram staining, negative staining and acid-fast staining.
4.2 Sterilization techniques (physical & chemical sterilization).
4.3 Culture media & conditions for microbial growth.
4.4 Pure culture isolation: Streaking, serial dilution and plating methods;
4.5 Cultivation,maintenance and preservation of pure cultures.
4.6 Beneficial and harmful microbes and their role in daily life.
4.7 Concept of disease in plant and animal caused bymicroorganism.

Text Books/ Reference Books:

1. M. T. Madigan;J. M. Martinko and J. Parker,2006, Brock Biology of Microorganisms, 13th Edition, Prentice Hall, IntInc Publication.

2. M. J. Pelczar et al, 2009, Microbiology: Concepts and Application, 10th Ed, Tata McGraw Hill Publication,.
3. Prescott et al., 2017, Microbiology : 10th Edition, McGraw Hill Publication,
4. G.J.Tortora, B.R.Funke, C.L.Case, 2015, Microbiology An Introduction, 12th Edition, Benjamin-Cummings Publishing Company.
5. R.Y.Stainier, J.L.Ingraham, M.L.Wheelis and P.R.Painter, 1992, General Microbiology, 5th Edition, McMillan Publications.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-101)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-101.1	2	-	2	1	2	1	1
BMB-DS-101.2	2	1	2	1	2	1	1
BMB-DS-101.3	2	-	2	1	2	1	1
BMB-DS-101.4	2	2	2	1	2	1	1

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BMB-DS-102: BACTERIOLOGY AND SYSTEMATICS

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course learning outcomes:The students are able to –

BMB-DS-102.1. Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella orpili.

BMB-DS-102.2. Categorize bacteria depending on the nutritional requirements for growth.

BMB-DS-102.3.Understand Systematics for discovering the fundamental units of bacterial diversity

BMB-DS-102.4Differentiate bacteria and archaebacteria based on their Diversity and Evolution

Unit 1 BacterialMorplology

1.1 Cell size, shape and arrangement, capsule, flagella, fimbriae and pili.
1.2 Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls,
1.3 archaebacterial cell wall,
1.4Gram and acid-fast staining mechanisms,
1.5 lipopolysaccharide (LPS),sphaeroplasts, protoplasts, and L-forms.
1.6 Effect of antibiotics and enzymes on the cell wall.
1.7Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.
1.8Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid. Endospore: Structure, formation, stages of sporulation.

Unit 2 Nutrition in Bacteria

3.1 Nutritional requirements in bacteria and nutritional categories.
3.2 Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, enriched and enrichment media.
3.3 Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation.
3.4 Chemical methods of microbial control: disinfectants, types and mode of action.
3.5 Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.

Unit 3 Systematics

4.1Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain;
4.2 conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing and its importance.
4.3 Differences between eubacteria and archaebacteria.

Unit 4 Phylogenetic overview of bacteria and archaebacteria

4.1 Study of typical eubacteria (*Bacillus*, *Clostridium*, *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Mycobacterium*, *Escherichia*, *Salmonella*, *Shigella*, *Vibrio*, *Helicobacter*,*Meningococcus*, Spirochetes, *Rickettsia*, *Mycoplasma* and *Chlamydia*.

4.2 General characteristics and phylogenetic overview of archaebacteria.
4.3 Introduction to Nanoarchaeota (*Nanoarchaeum*), Crenarchaeota (*Sulfolobus*, *Thermoproteus*) and Euryarchaeota [Methanogens (*Methanobacterium*, *Methanocaldococcus*), thermophiles (*Thermococcus*, *Pyrococcus*, *Thermoplasma*), and Halophiles (*Halobacterium, Halococcus*)].

Text Books/ Reference Books:

1. G.J.Tortora, B.R.Funke, C.L.Case, 2015, Microbiology An Introduction, 12th Edition, Benjamin-Cummings Publishing Company.
2. Prescott et al., 2017, Microbiology : 10th Edition, McGraw Hill Publication,
3. M. T. Madigan;J. M. Martinko and J. Parker,2006, Brock Biology of Microorganisms, 13th Edition, Prentice Hall, IntInc Publication
4. M. J. Pelczar et al, 2009, Microbiology: Concepts and Application, 10th Ed, Tata McGraw Hill Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	**Weightage**
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-102)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-102.1	2	-	2	1	2	1	1
BMB-DS-102.2	2	1	2	1	2	1	1
BMB-DS-102.3	2	-	2	1	2	1	1
BMB-DS-102.4	2	2	2	1	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BMB-DS-103: CELL BIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 0	3	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BMB-DS-103.1 Describe the ultra-structure and function of cell organelles.
BMB-DS-103.2 Discover the protein sorting and export by different organelles
BMB-DS-103.3 Assimilate various functions of cytoskeleton.
BMB-DS-103.4 Appraise the mechanism of specialized cell.

Unit 1: An Overview of Cells
1.1 Brief History, Cell theory
1.2 Overview of Prokaryotic and Eukaryotic Cells
1.3 Plant and Animal cells
1.4 Cell organelles
1.5 Cell Division
1.6 Cell cycle and its regulation
1.7 Flagella, Pili and Capsule
1.8 Phages, Virioids, Mycoplasmas

Unit 2: Protein Sortingand Transport
2.1 Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER
2.2 processing and quality control in ER
2.3 smooth ER and lipid synthesis, export of proteins and lipids
2.4 Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus
2.5 Active and passive transport
2.6Proton pumps associated (Na-K, Ca, calmodulin etc. and their distribution)
2.7Phagocytosis, pinocytosis, exocytosis.
2.8Solute transport by Simple diffusion

Unit 3: Cytoskeleton and Cell Movement
3.1Glycocalyx, Cell-cell interactions/ Junction, pit connections in plants and animal.
3.2 adherens junctions, tight junctions, gap junctions, and plasmodesmata
3.3 Structure and organization of actin filaments
3.4 actin, myosin and cell movement
3.5 intermediate filaments
3.6 microtubules.

Unit 4: Specialized cells
4.1 Motile cells (amoeboid, ciliary, flagellar movements)
4.2 Nerve cells and nerve impulse conduction

4.3 Muscle cells and muscle contraction
4.4 Receptor –integrin
4.5 Apoptosis

Text Books/ Reference Books:

1. D.E.Sadava, 2009,CellBiology,Jones and Bartlett Publication.
2. De Robertes,2017, Cell and Molecular Biology,8th Edition,Panima Publication.
3. Albert ,Essential of Cell Biology: Garland Publication, 5th Edition.ISBN-13: 978-0393680379
4. G.M.Cooper,2015,The Cell: A Molecular Approach,7th Edition, ASM Press Publication.
5. Albert et al,2014, Molecular Biology of Cell,6th Edition,John Wiley and Sons Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	**Weightage**
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement BMB-DS-103	**PO1**	**PO2**	**PO3**	**PO4**	**PSO1**	**PSO2**	**PSO3**
BMB-DS-103.1	2	3	2	2	3	3	3
BMB-DS-103.2	3	-	-	-	3	-	2
BMB-DS-103.3	3	2	1	1	3	1	1
BMB-DS-103.4	3	3	2	2	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-151: BASIC MICROBIOLOGY LAB

Periods/week Credits	Max. Marks :100
P: 2 2	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Course learning outcomes: At the conclusion of this course the students -
BMB-DS-151.1. learn the principle and applications of important instruments
BMB-DS-151.2. learn sterilization techniques
BMB-DS-151.3. know the general morphology of microorganisms
BMB-DS-151.4 demonstrate the presence of microflora in the environment

List of Experiments:

1. Microbiology Good Laboratory Practices andBio-safety.
2. To study the principle and applications of important instruments (biological safety cabinets,autoclave,incubator,BODincubator,hotairoven,lightmicroscope,pH meter) used in the microbiology laboratory.
3. Preparation of culture media (liquid & solid) for bacterialcultivation.
4. Handling and care of laboratory equipment - autoclave, hot air oven, incubator, and laminarairflow.
5. Sterilization of media using autoclave and assessment ofsterility.
6. Sterilization of glassware using hot airoven.
7. Sterilization of heat sensitive material by membranefiltration.
8. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates toair.
9. Observation of microorganisms - bacteria, cyanobacteria protozoa, fungi, yeasts, and algae from naturalhabitats.
10. Study of common fungi, algae and protozoan using temporary / permanentmounts

Reference Books

1. K.R.Aneja, 2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
2. J.Cappucinno&N.Sherman, 2014, Microbiology –A Lab manual, 11th Edition, Addison Wesley Publication.
3. G.J. Tortora,2016, Microbiology, 12th Edition, Pearson Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-151**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BMB-DS-151.1	3	3	-	2	1	2	3	1
BMB-DS-151.2	3	3	-	1	3	1	3	2
BMB-DS-151.3	3	3	1	2	1	3	2	1
BMB-DS-151.4	3	3	-	1	2	1	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-152: BACTERIOLOGY LAB

Periods/week Credits	Max. Marks :100
P: 2 2	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Course Type: Core

Course learning outcomes:

The students will beable to-

BMB-DS-152.1 Prepare different types of culture media.

BMB-DS-152.2 Learn and perform different staining techniques.

BMB-DS-152.3 Learn isolation and preservation of microorganisms

BMB-DS-152.4 Enumerate colony forming units from a given source

List of Experiments:

1. Preparation of different media: synthetic media, complex media- Nutrient agar, McConkey agar, EMBagar.
2. To perform Simplestaining
3. To perform Negativestaining
4. To perform Gramstaining
5. To analyze Acid fast staining – study using permanentslide.
6. To perform Capsulestaining
7. To perform Endosporestaining.
8. Isolation of pure cultures of bacteria by streakingmethod.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging dropmethod.

Reference Books

1. K.R.Aneja, 2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
2. J.Cappucinno & N.Sherman, 2014, Microbiology –A Lab manual, 11th Edition, Addison Wesley Publication.
3. G.J. Tortora,2016, Microbiology, 12th Edition, Pearson Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-152**)**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BMB-DS-152.1	3	3	3	2	1	2	3	1
BMB-DS-152.2	3	3	1	1	3	1	3	2
BMB-DS-152.3	3	3	1	2	1	3	2	1
BMB-DS-152.4	3	3	1	1	2	1	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BMB-DS-153: CELL BIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 2	1.5	Continuous Assessment	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:

The students will be able to-

BMB-DS-153.1 identify various microscopic objects and artifacts in the biological specimen using microscope

BMB-DS-153.2 demonstrate practical skills in staining the biological samples for observing morphology and histology of cells and tissues.

BMB-DS-153.3 apply the technique of cytometry to determine the cell size, number and viability.

BMB-DS-153.4compare different stages of cell division and evaluate the mitotic index.

List of Experiments:

1. To study the compound microscope and observe common interfering objects.
2. To study and observe the structure of prokaryotic cell.
3. To study and observe the structure of eukaryotic cell.
4. To isolate lactobacillus from curd sample.
5. To study the histology of different tissues.
6. To count the number of cells using haemocytometer.
7. To study the cell membrane properties.
8. To study the morphology of nuclei in human leucocytes.
9. To determine cell viability using Trypan Blue.
10. To study cellular division in onion root tip & calculate mitotic index (MI).

Text Books/Reference Books:

1. Cytological Technique: John R. Baker, Methuen & Co. Publication. ((1960)
2. Practical skills in Biomolecular Sciences: Reed, Pearson Publication, (2016), 5thEdition.
3. Cell Biology : Practical Manual Paperback – 1: Dr.Renu Gupta, Dr.SeemaMakhija, Dr. Ravi Toteja, Prestige Publishers (2018)

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement BMB-DS-153	**PO1**	**PO2**	**PO3**	**PO4**	**PSO1**	**PSO 2**	**PSO 3**
BMB-DS-153.1	2	3	2	2	3	3	3
BMB-DS-153.2	3	2	1	1	2	2	3
BMB-DS-153.3	3	2	1	1	2	1	1
BMB-DS-153.4	3	3	2	2	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BHM 201: ENGLISH

Periods/week Credits	Max. Marks: 100
L: 2 T:0 P:0 2	Continuous Evaluation: 50
Duration of Exam: 2 Hours	External (Written): 50

Prerequisites:
Students are expected to have an inclination towards understanding the need for life skills required to succeed in their career and should know Basic English.

Course Type: Program Core

Course Outcomes: The students would be able to-
BHM 201.1.Speak in English confidently
BHM 201.2.Acquire proficiency in reading and writing skills
BHM 201.3.Communicate in grammatically correct English.
BHM 201.4.Create and deliver presentations confidently.
BHM 201.5 Understand the meaning of professional communication.

Unit 1. Vocabulary Building
1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

Unit 2. Basic Writing Skills
2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

Unit 3. Identifying Common Errors in Writing
3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

Unit 4. Nature and Style of sensible Writing
4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

Unit 5. Writing Practices
5.1 Email Writing
5.2 Cover Letter
5.3 Essay

Unit 6. Oral Communication

6.1Listening Comprehension
6.2 Pronunciation, Intonation, Stress and Rhythm
6.3Common Everyday Situations: Conversations and Dialogues
6.4 Communication at Workplace
6.5Interviews
6.6Formal Presentations

Text Books/Reference Books:

- F.T. Wood.2007, Remedial English Grammar. Macmillan.
- William Zinsser,2001, On Writing Well, Harper Resource Book.
- Liz Hamp-Lyons and Ben Heasly. 2006, Study Writing. Cambridge University Press.
- Sanjay Kumar and PushpLata, 2011, Communication Skills. Oxford University Press.

Web links:

- https://www.mindtools.com/
- https://www.slideshare.net/
- http://ndl.iitkgp.ac.in
- hbx.hbs.edu

Distribution of Continuous Evaluation:

Sessional 1	15%
Sessional 2	15%
Assignment	10%
Class Performance	5%
Attendance	5%
End Term Exam	50%

Instructions for Paper Setting:

- Section A- MCQ's- 30 marks
- Section B- 2 short questions- 10 marks
- Section C- 2 short questions, 10 marks

Assessment Tools:

- Assessment of sessional 1 through In Class Presentations.
- Continuous evaluation
- Assignments
- Attendance
- Marks for Behavior and soft skills displayed in the class

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 3	PSO 4
BHM 201.1	-	-	-	1	-	-	-	1
BHM 201.2	-	-	-	-	-	-	-	1
BHM 201.3	-	-	-	-	-	-	-	-
BHM 201.4	-	-	-	-	-	-	1	1
BHM 201.5	-	-	-	-	-	-	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-121: HEREDITARY AND EVOLUTION

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course learning outcomes: By the conclusion of this course, the students have -

BMB-DS-121.1 describe the history of genetics and the basic laws that govern inheritance
BMB-DS-121.2 understand and classify extensions and deviations from the Mendel's Laws of inhertance
BMB-DS-121.3 understand genetic recombination and interpret its role in gene mapping.
BMB-DS-121.4 describe the structural organization of chromosomes and the effect of change in chromosome number or structure on diseases.

Unit 1 Introduction to Genetics

1.1Historical developments, Model organisms in genetic analyses and experimentation
1.2 Mendel's Laws(Dominance, segregation, independent assortment)
1.3 Deviation from Mendelianinheritance
1.4 Rediscovery of Mendel's principles
1.5 Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests.

Unit 2 Non-Mendelian Genetics

2.1Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance
2.2 Multiple alleles, Epistasis, penetrance and expressivity
2.3 Rules of extra nuclear inheritance
2.4 Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces,
2.5 Maternal effects – Shell coiling in Limnaeaperegra, Infectious heredity - Kappa particles in Paramecium.

Unit 3 Linkage, Crossing over and gene mapping

3.1Linkage and recombination of genes
3.2Cytological basis of crossing over, Crossing over at four-strand stage
3.3Molecular mechanism of crossing over, gene mapping in Eukaryotes: Gene recombination and the role of chromosomal exchange
3.4 constructing genetic maps, Tetrad analysis
3.5 gene mapping in Bacteria by conjugation, transformation and transduction
3.6 Mapping bacteriophage genes
3.7Fine-structure analysis of a bacteriophage gene.

Unit 4 Characteristics of Chromosomes

4.1Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, 4.2 Packaging DNA molecules into chromosomes
4.2Concept of euchromatin and heterochromatin
4.3 Normal and abnormal karyotypes of human chromosomes
4.4 Chromosome banding, Giant chromosomes: Polyteneandlampbrush chromosomes
4.5 Variations in chromosome structure: Deletion, duplication, inversion and translocation

4.6Variation in chromosomal number and structural abnormalities

Text Books/ Reference Books:

1. Gardner ,Principles of Genetics:, John Wiley & Sons Publication.
2. R. J. BrookerGenetics: Analysis and Principles,McGraw Hill Science Publication.
3. M.W StrickbergerGenetics:, Prentice HallCollege Division Publication.
4. Daniel Hartl ,Genetics: Analysis of genes and genomes:, Jones and Bart let Publication.
5. Genetics: P.J Russel, Addison Wesley Longman Inc. Publication, California.
6. W. S. Klug, M. C. Spencer and M. A, PalladinoConcept of Genetics:, Benjamin Cumming Publication.
7. Benjamin Pierce, Genetics:, W. H Freeman Publication.
8. D.l L. Hartl and E. W. Jones, Essential of Genetics :A Genomic perspective:, Jones and Bart let Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-121)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-121.1	2	2	-	-	2	2	1
BMB-DS-121.2	3	3	2	1	2	2	1
BMB-DS-121.3	3	3	2	2	2	2	2
BMB-DS-121.4	3	3	3	3	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-154: HEREDITARY AND EVOLUTION LAB

Periods/week Credits	Max. Marks :100
P: 2 2	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Course learning outcomes:

The students will be able to-

BMB-DS-154.1Understand mendelian deviations in dihybrid crosses.

BMB-DS-154.2 Develop practical skills to do karyotyping and pedigree analysis.

List of Experiments:

1. To study Mendelian deviations in dihybridcrosses
2. To Study Barr Body with the temporary mount of human cheekcells
3. To study*Rhoeo*translocation with the help ofphotographs
4. To Perform Karyotyping
5. To undergo Chi-SquareAnalysis
6. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas/ Drosophila*larvae
7. Study of pedigreeanalysis
8. Analysis of a representative quantitative trait

Reference Books:

1. M.W Strickberger, Genetics:, Prentice HallCollege Division Publication.
2. Daniel Hartl ,Genetics: Analysis of genes and genomes:, Jones and Bart let Publication.
3. Benjamin Pierce, Genetics:, W. H Freeman Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	**Weightage**
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-154**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BMB-DS-154.1	3	3	3	2	1	2	3	1
BMB-DS-154.2	3	3	1	1	3	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-122: MICROBIAL TECHNOLOGY

Periods/week Credits	Max. Marks : 200
L: 4 T: 0 4	Continuous Assessment : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Course learning outcomes: The students will be able to

BMB-DS-122.1. understand the relevance of Microbiology to technological developments for agriculture and environment and other applied areas

BMB-DS-122.2develop understanding regarding the source for the isolation of microorganisms of industrial importance from the environment and

BMB-DS-122.3develop an understanding of the downstream processing for product recovery and cultural and genetic manipulation of these microorganisms in order to produce more of these useful products

Unit 1 Microbial Biotechnology and its Applications

1.1Microbialbiotechnology:Scopeanditsapplicationsinhumantherapeutics,agriculture(Biofertilizers, PGPR, Mycorrhizae), environmental, and foodtechnology

1.2 Useofprokaryoticandeukaryoticmicroorganismsinbiotechnologicalapplications, Isolation methods of industrially important microorganisms.

1.2 screening methods of industrially important microorganisms

1.3 Improvement of industrial microorganisms using classical methods

1.4 Improvement of industrial microorganisms using recombinant DNA approaches.

1.5 Preservation methods

Unit 2 Therapeutic and Industrial Biotechnology

2.1Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis Bvaccine)

2.2 Microbialpolysaccharidesandpolyesters,

2.3Microbialproductionofbio-pesticides,bioplastics

2.4Microbial biosensors

Unit 3 Applications of Microbes in Biotransformations and in production of bio energy

3.1 Microbial based transformation of steroids and sterols

3.2 Bio-catalyticprocessesandtheirindustrialapplications:Productionofhighfructosesyrupand production of cocoa buttersubstitute

5.1 Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass,

5.2 Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal 5.3 of heavy metals from aqueous effluents

Unit 4 Microbial Products and their Recovery

4.1 Microbial product purification: filtration, ion exchange & affinity chromatography techniques

4.2Immobilization methods and their application: Whole cellimmobilization

4.3Microbial product purification: filtration, ion exchange & affinity chromatography techniques

4.4. RNAi and its applications in silencing genes, drug resistance, therapeutics, and host pathogen

interactions

Text Books/ Reference Books:

1. W. Cruger and A. Cruger,2002, Biotechnology: A handbook of Industrial Microbiology, 3rd Edition, Panima Publication.
2. P. F. Stanbury and A. Whittaker,2016. Principles of fermentation technology, Pergamon press Publication.
3. Peppler and Perlman,1979, Microbial technology: Fermentation technology, 2nd edition, Elsevier Publication.
4. R.G. Harrison, P.Todd, S.R. Rudge and D.P Petrides,2002, Bioseparations Science and Engineering, Oxford Press Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-122)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-122.1	2	2	-	-	2	2	1
BMB-DS-122.2	3	3	2	1	2	2	1
BMB-DS-122.3	3	3	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-155: MICROBIAL TECHNOLOGY LAB

Periods/week Credits	Max. Marks :100
P: 2 2	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Course learning outcomes: The student will be able to
BMB-DS-155.1 study immobilization techniques
BMB-DS-155.2 study enzyme activity
BMB-DS-155.3 isolate antibiotic producing bacteria and isolate UV induced auxotrophic mutants

List of Experiments:

1. Study yeast cell immobilization in calcium alginategels
2. Study enzyme immobilization by sodium alginatemethod
3. Pigment production from fungi (*Trichoderma*/ *Aspergillus*/*Penicillium*)
4. Isolation of xylanase or lipase producingbacteria
5. Study of algal Single CellProteins
6. To compare the amylase activity of different isolates.
7. Isolation of protease secreting microorganisms from soil.
8. Isolation of UV induced auxotrophic mutants by replica plate technique.
9. Isolation of antibiotic producing microorganisms from soil.
10. Industrial visit (to study the role of yeast in baking industry

Reference Books:

1. J.&Sheeman N., Addison Cappuccino ,Microbiology lab. Manual Wesley Publication, California.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-155**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BMB-DS-155.1	3	3	3	2	1	2	3	1
BMB-DS-155.2	3	3	1	1	3	1	3	2
BMB-DS-155.3	3	3	1	2	1	3	2	1

SEMESTER-II

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-201: BIOMOLECULES

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The students will be able to-

BMB-DS-201.1. develop a very good understanding of various biomolecules, which are required for the development & functioning of a cell as well as learn about the interactions among various biomolecules.

BMB-DS-201.2. developean understanding about howcarbohydratesand lipids act as structural and functional components such as energy generation and as storage food molecules for cells.

BMB-DS-201.3. become well conversant about multifarious functions of proteins; are able to calculate enzyme activity and other quantitative and qualitative parameters of enzyme kinetics.

BMB-DS-201.4. learn about the structure of nucleic acids, features of bacterial genomes, types of vitamins and their significance.

Unit 1: Carbohydrates

1.1 Families of monosaccharides – aldoses and ketoses, trioses, tetroses, pentoses, and hexoses.

1.2 Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose.

1.3 Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, sugar derivatives, glucosamine.

1.4 Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, polysaccharides, storage polysaccharides, starch and glycogen.

1.5 Structural polysaccharides, cellulose, peptidoglycan and chitin.

Unit 2: Lipids

2.1 Definition and major classes of storage and structural lipids.

2.2 Fatty acids, structure and functions. Essential fatty acids. Triacylglycerols structure, functions and properties. Saponification.

2.3 Phospholipids: Building blocks, general structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide.

2.4 Special mention of sphingomyelins, cerebrosides and gangliosides.

2.5 Lipid functions: cell signals, cofactors, prostaglandins.
Introduction to lipid micelles, monolayers, bilayers.

Unit 3: Proteins

3.1 Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its significance. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D-glutamic acid.

3.2 Primary, secondary, tertiary and quaternary structures of proteins.

3.3 Enzymes: Classification of enzymes, Apoenzyme and cofactors, prosthetic group-TPP, coenzyme - NAD, metal cofactors.

3.4 Mechanism of action of enzymes: active site, transition state complex and activation energy.
3.5 Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, K_M, and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number, Effect of pH and temperature on enzyme activity.
3.6 Enzymeinhibition: competitive- sulfa drugs; non-competitive-heavy metal salts. Modes of catalysis.

Unit 4: Nucleic acids and vitamins

4.1 Biosynthesis of nucleotides.
4.2 Base composition A+T and G+C rich genomes.
4.3 Structure and functions of DNA.
4.4 Structure and functions of RNA.
4.5 Basic concept of nucleic acids protein interactions.
4.6 Concept and types of vitamins and their role in metabolism.

Text Books/ Reference Books:

1. Tortora, G.J., Funke, B.R and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore,(2004).
2. Stanbury,Biochemistry
3. Voet. Fundamentals of biochemistry Wiley
4. M.M. Cox, D. L. Nelson.Lehninger's principles of biochemistry.
5. W HFreemanStryer. Biochemistry

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-201)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-201.1	1	-	2	3	3	-	3
BMB-DS-201.2	1	1	2	3	3	-	3
BMB-DS-201.3	1	1	2	3	3	-	3
BMB-DS-201.4	1	1	2	3	3	-	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-202: MICROBIAL TECHNIQUES & INSTRUMENTS

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-

BMB-DS-202.1 develop understanding of techniques and instruments which are commonly used in a microbiology laboratory.

BMB-DS-202.2 appraise the importance of sampling and measurements in experimentation.

BMB-DS-202.3 apply appropriate bioanalytical technique for identification, separation, isolation and purification of microbes and their products.

BMB-DS-202.4 perform qualitative and quantitative analysis of microbes and their products after their isolation.

Unit 1: Principles of Instrumentation

1.1 Experimentation and Measurements
1.2 Performance indicators of an instrument
1.3 Accuracy &Precision
1.4 Instrument Errors
1.5 Principles of Calibration

Unit 2: Microscopy

2.1 Principles of Microscopy- magnification, resolution and contrast
2.2 Technical arrangement and working of a Compound Microscope
2.3 Bright Field Microscopy
2.4 Dark Field Microscopy
2.5 Phase Contrast Microscopy

Unit 3: Centrifugation and Chromatography

3.1 Principles of Centrifugation
3.2 Types of centrifuges and their applications
3.3 Types of Chromatographic systems
3.4 Paper Chromatography and Thin Layer Chromatography
3.5 Fundamentals of High Pressure Liquid Chromatography

Unit 4: Electrophoresis and Spectroscopy

4.1 Principles of Electrophoresis
4.2 Electrophoresis of proteins
4.3 Electrophoresis of nucleic acids
4.4 Basic concepts of Spectroscopy
4.5 UV- Visible Spectrophotometry

Text Books/Reference Books:

1. K. Wilson and J. Walker, 2000, Principles and techniques of Practical Biochemistry,5th Edition,Cambridge University Press Publication.
2. D. Friefelder, 2009, Physical Biochemistry,12th Edition,W. H. Freeman and company Publication.
3. F. J. Dechow,2005, Separation and Purification Techniques in Biotechnology,1st Edition Standard Publishers.
4. K. E. Vanholde, 1999, Physical Biochemistry, Prentice Hall Inc. Publication,
5. R. D. Braun ,2012, Introduction to Instrumental Analysis: 2nd Edition, McGraw Hill International Edition, Chemistry Series Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-202)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-202.1	3	3	2	2	2	2	2
BMB-DS-202.2	3	3	3	3	2	2	2
BMB-DS-202.3	3	3	3	3	3	3	3
BMB-DS-202.4	3	3	3	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-203: FOOD AND DAIRY MICROBIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course learning outcomes: The students will

BMB-DS-203.1. Identify and explain the factors affecting growth of microbes in food and Food Preservation

BMB-DS-203.2. describe the role of microorganisms in the production of fermented foods and assess the utilization of food waste for production of valuables

BMB-DS-203.3. identify the role of microorganisms in the causation of the diseases

BMB-DS-203.4. summarize and critically discuss current topics of importance in food microbiology including food sanitation, genetically modified foods, detection methods etc

Unit1Factors affecting microbes and Food Preservation

1.1 Intrinsic and extrinsic factors that affect growth and survival of microbes in foods

1.2 natural flora and source of contamination of foods in general.

1.3 Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

1.4Principles of food preservation: temperature, canning, drying, irradiation, microwave processing andaseptic packaging,

1.5chemical methodsof food preservation:salt,sugar,organicacids,SO2,citrates,benzoates nitrite and nitrates etc.

Unit2Dairy Microbiology

2.1 Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh,

2.2Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

2.3 Utilization and disposal of dairy by-product – whey.

Unit3Food borne diseases

3.1 Causative agents, foods involved, symptoms and preventive measures-Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins;

3.2 Causative agents, foods involved, symptoms and preventive measures- Food infections: *Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis,Shigellosis, Yersinia enterocolitica, Listeria monocytogenesandCampylobacterjejuni*

Unit4Food sanitation and control

4.1 HACCP, Indices of food sanitary quality and sanitizers.

4.2Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology.

4.3 Genetically modified foods, Nutraceuticals,

4.4 Biosensors infood

4.5Applications of microbial enzymes in dairy industry [Protease, Lipases etc].

Text Books/Reference Books:

1. J.M.Jay,2005, Modern Food Microbiology: VNR Publication, New York.
2. M.R.Adams,2008, Food Microbiology: Royal Society of Chemistry, Publication.
3. N.M.Potter, 2007,Food Science: The AVI Publishing Co, Westport Connecticut, USA.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-203)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-203.1	3	3	2	2	2	-	2
BMB-DS-203.2	3	3	3	3	2	-	2
BMB-DS-203.3	3	3	3	3	3	-	3
BMB-DS-203.4	3	3	3	3	3	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-251 : BIOMOLECULES LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Assessment	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course Type: Program Core

Course Outcomes: The students will be able to
BMB-DS-251.1 learn the preparation of different solutions, reagents and buffers used in biochemistry.
BMB-DS-251.2 estimate the biomolecules qualitatively and quantitatively.
BMB-DS-251.3 analyze the effects of temperature and pH on enzyme activity.
BMB-DS-251.4 Carry out the Biochemical analysis of biological samples

List of Experiments:
1. Preparation of buffers and solutions of various concentrations.
2. Qualitative estimation of amino acids and proteins.
3. Spectrophotometric estimation of Proteins by Lowry's method.
4. Qualitative estimation of carbohydrates and lipids.
5. Quantitative estimation of carbohydrates by anthrone method.
6. To study extraction of lipids and saponification of fats.
7. To study the effect of temperature and pH on salivary amylase activity.
8. Biochemical analysis of normal and abnormal constituents of urine.
9. Determination of K_m and V_{max} for salivary amylase.
10. Quantitative determination of DNA and RNA by spectrophotometric method.

Reference Books:

1. Introductory Practical Biochemistry: S.K. Sawhney and Randhir Singh, Narosa Publishing House, New Delhi.
2. An introduction to Practical Biochemistry: David T. Plummer, McGraw Hill Book Company Publication, UK.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-251)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-251.1	1	1	3	3	2	3	3
BMB-DS-251.2	1	1	3	3	2	3	3
BMB-DS-251.3	1	1	3	3	2	3	3
BMB-DS-251.4	1	1	3	3	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-252: BASIC INSTRUMENTATION LAB

Periods/week Credits	Max. Marks :100
P: 3 1.5	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Course outcomes:

The students will be able to-
BMB-DS-252.1 identify the usage of various bioanalytical instruments for an experiment.
BMB-DS-252.2 select appropriate bioanalytical instrument for an experiment.
BMB-DS-252.3 use suitable technique for efficient separation of different biomolecules.
BMB-DS-252.4 implement a suitable technique for characterization of different biomolecules.

List of Experiments:

1. To study bacterial morphology using compound microscope.
2. To study fungal morphology using compound microscope.
3. To study microbiological slides/ specimen using Phase Contrast Microscope.
4. To isolate microbial cells using differential centrifugation technique.
5. To separate microbial products through paper chromatography.
6. To separate microbial products through thin layer chromatography.
7. To separate and characterize microbial products through HPLC.
8. To separate and identify proteins by native PAGE.
9. To prepare a calibration curve using colorimeter.
10. To analysis and interpret the results of an autoradiograph.

Reference Books:

1. K.Wilson and J.Walker,2018, Principles & Techniques of Practical Biochemistry,8th Edition, Cambridge University Press Publication.
2. S.K.Sawhney and R. Singh, 2005,Introductory Practical Biochemistry, 5th Edition, NarosaPublising House.
3. D. T. Plummer,2017, An introduction to Practical Biochemistry,3th Edition, McGraw Hill Book Company Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-252**)**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-252.1	3	3	1	2	3	3	3
BMB-DS-252.2	3	3	1	1	3	3	3
BMB-DS-252.3	3	3	2	2	3	3	3
BMB-DS-252.4	3	3	2	1	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-253: FOOD AND DAIRY MICROBIOLOGY LAB

Periods/week Credits	Max. Marks :100
P: 3 1.5	Continuous Evaluation : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 50

Pre-requisites: knowledge of basic 10+2 science
Course Type: Core

Course outcomes:
The students will be able to-
BMB-DS-253.1: estimate the microbiological quality of various food items.
BMB-DS-253.2: appreciate the importance of detection methods employed for food items.
BMB-DS-253.3: appraise the principle and processes in production of various food items.
BMB-DS-253.4: assimilate the practical knowledge to solve food related problems of real world.

List of Experiments:

1. MBRT of milk samples and their standard platecount.
2. Microbiological analysis of different milk samples by standard platecount.
3. Isolation of any foodborne bacteria from food products.
4. Isolation ofspoilage microorganisms from spoiledvegetables/fruits.
5. Isolation of spoilage microorganisms frombread.
6. Production of Curd and examination of its microbiological quality.
7. To study the process of production of Brewer/Baker/Folder yeast.
8. To study and demonstration of the process of yogurt manufacture plant.
9. To study and demonstration of process of pasteurization to improve the storage quantities of milk, fruit juice and other food items.
10. To study the various physical methods such as heat, cold, dehydration, high osmotic pressure etc for preservation of food.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Reference Books:

1. M.R.Adams,2008,Food Microbiology, Royal Society of Chemistry Publication.
2. N.M.Potter, 2007, Food Science ,The AVI Publishing Co, Westport Connecticut, USA.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-253**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-253.1	3	3	3	2	1	2	3
BMB-DS-253.2	3	3	1	1	3	1	3
BMB-DS-253.3	3	3	1	2	1	3	2
BMB-DS-253.4	3	3	1	1	2	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

CH-202B: ENVIRONMENTAL STUDIES

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 0	3	Internal	: 100
Duration of Examination: 3 Hrs		External	: 100

Pre-requisites: Basic knowledge of Environment related issues
Course Type: Fundamental

Course Outcomes: The students will be able to:

CH-202B.1. describe the multidisciplinary nature of environmental studies and importance of different types of ecosystems
CH-202B.2. explain the significance of equitable use of natural resources and biodiversity conservation.
CH-202B.3.identifythe environmentalproblems
CH-202B.4.evaluate different environmental policies & practices
CH-202B.5.analyze ethical implications of environmental issues and disaster management
CH-202B.6.explain the duality of Chemistry

PART- A

Unit 1 : Introduction to environmental studies

1.1Multidisciplinary nature of environmental studies;
1.2 Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems

2.1 What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3 : Natural Resources : Renewable and Non-renewable Resources

3.1 Land resources and landuse change; Land degradation, soil erosion and desertification.
3.2 Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
3.3 Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
3.4 Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation

4.1 Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
4.2 India as a mega-biodiversity nation; Endangered and endemic species of India

4.3 Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
4.4 Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

PART-B

Unit 5 : Environmental Pollution

5.1 Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
5.2 Nuclear hazards and human health risks
5.3 Solid waste management : Control measures of urban and industrial waste.
5.4 Pollution case studies.

Unit 6 : Environmental Policies & Practices

6.1 Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.
6.2 Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
6.3 Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 7 : Human Communities and the Environment

7.1 Human population growth: Impacts on environment, human health and welfare.
7.2 Resettlement and rehabilitation of project affected persons; case studies.
7.3 Disaster management : floods, earthquake, cyclones and landslides.
7.4 Environmental movements :Chipko, Silent valley, Bishnois of Rajasthan.
7.5 Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
7.6 Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8: Chemistry for peaceful purposes

8.1 The duality of chemistry: Chemistry for peaceful purposes versus Chemical Weapons
8.2 Dual – use nature of toxic and precursor chemicals
8.3 Weapons of mass destructions, disarmament

Unit 9 : Field work*

9.1 Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
9.2 Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.
9.3 Study of common plants, insects, birds and basic principles of identification.
9.4 Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Suggested Readings:

1. *Environmental Chemistry,* by *A K De*
2. Green Chemistry, by V K Ahluwalia
3. Textbook for Environmental Studies, by ErachBarucha
4. The duality of Chemistry, Pure Appl. Chem., Vol. 80, No. 8, pp. 1763–1772, 2008 (Available online).

The break-up for Internal marks:

Sessional tests	:	40 marks
Attendance	:	10 marks
Field work & Report writing / Model making	:	50 marks

Instructions for paper setting End Semester Examination: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Course Articulation Matrix

CO Statement (CH-202 B)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO1**	**PSO2**	**PSO3**
CH-202B.1	1	2	1	-	-	-	-
CH-202B.2	1	2	1	-	-	-	-
CH-202B.3	2	2	3	-	-	-	-
CH-202B.4	1	2	3	-	-	-	-
CH-202B.5	1	2	2	-	-	-	-
CH-202B.6	1	2	3	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-221: BIOINFORMATICS

Periods/week	Credits	Max. Marks	: 200
L: 3 T:0	3	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination:	100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course Outcomes:

The students will be able to-
BMB-DS-221.1 Developed skills to use computers for analysis of biological data.
BMB-DS-221.2 Skill to use important biological databases, use tools to retrieve data, and comparethe data of the biological macromolecules
BMB-DS-221.3 Developed basic skills for data retrieval, representation, analysis and interpretation
BMB-DS-221.4 Connect the protein structure determination tools to prediction methods.

Unit 1: Computing Fundamentals
1.1 Introduction to bioinformatics and data generation
1.2 Bioinformatics and its relation with molecular biology
1.3 Data generation
1.4 Generation of large scale molecular biology data
1.5Data file formats(Genbank, DDBJ, FASTA, PDB, SwissProt)

Unit 2: Databases
2.1 Introduction to data types and source
2.2 Biological Database and its types
2.3 Nucleic acid databases (NCBI, DDBJ, and EMBL)
2.4Protein databases (Primary, Composite, and Secondary)
2.5Specialized Genome databases: (SGD, TIGR, and ACeDB)
2.6 Structure databases (CATH, SCOP, and PDBsum)

UNIT 3: Sequence Alignment
3.1 Alignments and Dynamic Programming
3.2 Local alignment and Global alignment (algorithm and example)
3.3 BLAST, PSIBLAST
3.4Multiple sequence alignment (Clustal W algorithm)
3.5 Challenges faced in integration of Biological data

Unit 4: Pairwise and Multiple Sequence Alignment
4.1 Hierarchy of protein structures.
4.2 Motifs, Folds and Domains
4.3modeling structural classes
4.4 Protein structure and rational drug design

Text Books / Reference Books:

1. A.D.Baxevanis and BF Francis Ouellette, 2004,Bioinformatics: a practical guide to the analysis of genes and proteins, 2nd Edition,John Wiley & Sons.
2. A.K.Lesk, 2019, Introduction to Bioinformatics,5th Edition, Oxford University Press.
3. D. Gusfield,2005,Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology, Cambridge University Press.
4. R.Durbin,S. Eddy, A. Krogh andG.Mitchison, 1998,Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids, Cambridge University Press.
5. D.W. Mount,2005, Bioinformatics Sequence and Genome Analysis,2nd Edition,Cold Spring Harbor Laboratory Press.

Web links:

www.ncbi.nlm.nih.gov
www.expasy.org
www.ebi.ac.uk

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-221)	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3
BMB-DS-221.1	1	3	3	3	3	3	3
BMB-DS-221.2	2	2	3	3	3	2	3
BMB-DS-221.3	3	2	2	2	3	3	3
BMB-DS-221.4	2	3	2	2	3	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-254: BIOINFORMATICS LAB

Periods/week	Credits	Max. Marks : 100
P: 2	1	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core
Course outcomes:
The students will be able to:
BMB-DS-254.1 develop a working knowledge of using various tools of bioinformatics and use of databases
BMB-DS-254.2 demonstrate the local and global alignment search tools for DNA sequence analysis
BMB-DS-254.3 determine molecular weight and secondary structure of proteins.
BMB-DS-254.4 infer molecular modeling by Rasmol and Cn3D.

List of Experiments:

1. To study literature searches method using Pubmed.
2. To study bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
3. Sequence retrieval usingBLAST
4. To perform multiple sequence analysis using CLUSTAL- W.
5. To analyze molecular weight of proteins using PROTPRAM.
6. To perform molecular modeling and study dynamics using RASMOL.
7. To compute and verify restriction maps in a given DNA sequencing data.
8. To study Gene finding tools (Glimmer, GENSCAN).
9. Prediction of different features of a functionalgene.
10. To study phylogenetic trees using suitable tool.

Text Books / Reference Books:

1. A.D.Baxevanis and BF Francis Ouellette,2004,Bioinformatics: a practical guide to the analysis of genes and proteins,2nd Edition, John Wiley & Sons.

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Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-254)	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-254.1	3	3	3	3	3	3	3
BMB-DS-254.2	3	2	2	2	3	2	2
BMB-DS-254.3	3	3	2	3	2	1	1
BMB-DS-254.4	2	3	2	2	3	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-222: SOIL MICROBIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course Outcomes:

The students will be able to-

BMB-DS-222.1 identify the diversity of microbes and recognize their role in soil ecosystems.

BMB-DS-222.2 explain the theoretical basis of the tools, technologies and methods common to soil microbiology.

BMB-DS-222.3 differentiate the different types of physiological processes carried out by bacteria.

BMB-DS-222.4 formulate strategies to enhance beneficial microorganisms in soil for its improvement.

Unit 1: Microbial Ecology

1.1 Soil environment, Soil microbial ecology,

1.2 Microbial communities in soil-Bacteria, Actinomycetes, Fungi, Algae, Protozoa, Viruses.

1.3 Different interfaces of interaction-Soil microbe,

1.4 soil-plant- microbe leading to symbiotic (mycorrhizal and rhizobial), associative, endosymbiotic and pathogenic interactions,

1.5 unculturable soil biota, plant growth promoting rhizobacteria,

1.6 Soil enzyme activities and their importance,

Unit 2: Biogeochemical Cycles

2.1 The carbon cycle: Organic matter decomposition,

2.2 Microbiology of cellulose, hemicellulose, Lignin decomposition

2.3 The nitrogen cycle: Mineralization and immobilization of nitrogen, Nitrification, Denitrification,

2.4 Nitrogen fixation: Symbiotic and non symbiotic

Unit 3: Mineral Transformations

3.1 Microbial transformations of phosphorous,

3.2 sulphur, iron and manganese in soil.

3.3 Siderophores and antimicrobials, Biodegradation of pesticides,

3.4 Organic wastes and their use in the production of biogas and manures

Unit 4: Techniques to study soil microbial biodiversity

4.5 Different methods to assess soil microbial biodiversity:-nucleic acid re-association and hybridization, low molecular weight RNA fingerfrinting,

4.6 PCR based techniques like denaturing gradient gel electrophoresis,

4.7 single stranded conformation polymorphism, amplified ribosomal DNA restriction analysis etc.

4.8 Metagenomics

Text Books/ Reference Books:

1. M.Alexander, Soil Microbiology, John Wiley Publication.
2. L.E. Hawker & A.H. Linton, Microorganisms Function, Form and Environment:. Edward Arnold, Royal Society of Chemistry Publication.
3. E.A. Paul, Soil Microbiology, Ecology and Biochemistry, Academic Press Publication.

4. D.M. Sylvia, J.J. Fuhrmann, P.T. Hartlly&D.Zuberer, Principles and Applications of Soil Microbiology: Pearson Prentice Hall Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-222)	PO1	PO2	PO3	PO4	PSO1	PSO 2	PSO 3
BMB-DS-222.1	2	2	1	1	2	-	2
BMB-DS-222.2	3	-	-	2	2	2	2
BMB-DS-222.3	2	1	-	2	1	-	1
BMB-DS-222.4	2	2	3	3	3	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-255: SOIL MICROBIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Evaluation	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Course outcomes:

The students will be able to-

BMB-DS-255.1 Estimate microbial population in a given sol sample

BMB-DS-255.2 Isolate Plant growth promoting microorganisms from plant/soil sample

BMB-DS-255.3 Determine the Plant growth promoting attributes of the isolated MOs.

BMB-DS-255.4 carry out the chemical analysis of soil sample

List of Experiments:

1. Enumeration of bacterial population in a given soil sample.
2. Enumeration of fungi in a given soil sample.
3. Enumeration of actinomycetes in a given soil sample.
4. Isolation of rhizobium from root nodules.
5. Isolation of Azotobacter from soil.
6. Isolation of azospirillum from roots.
7. Isolation of BGA.
8. Isolation of Phosphate solubilizing bacteria from soil .
9. Determination of phosphate solubilizig efficiency by Qualitative and quantitative methods.
10. Determination of macronutrient and micronutrients in soil sample.

Text/Reference Books:

1. K.R.Aneja,2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
2. J.Cappucinno&N.Sherman, 2014,Microbiology –A Lab manual,11th Edition, Addison Wesley Publication.
3. G.J. Tortora,2016,Microbiology,12th Edition, Pearson Publication.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-255)	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-255.1	3	3	3	3	3	3	3
BMB-DS-255.2	3	2	2	2	3	2	2
BMB-DS-255.3	3	3	2	3	2	1	1
BMB-DS-255.4	2	3	2	2	3	1	1

3rd Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-301: VIROLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course learning outcomes: The students will

BMB-DS-301.1 Understand about viruses and their chemical nature, different types of viruses infecting animals, plants and bacteria

BMB-DS-301.2. Understand the biology of bacteriophages.

BMB-DS-301.3. Gain knowledge of a variety of plant viruses and animal viruses.

BMB-DS-301.4. Acquire the ability to analyze principles of antivirals

Unit-1: History and Classification

1.1 Discovery of Viruses, nature, definition and general properties, concept of viroids, satellites and prions

1.2 Theory of viral origin, structure of viruses

1.3 Viral Taxonomy- Classification and Nomenclature, classical approach

1.4 Baltimore system of classification

Unit-2: Bacterial Viruses

2.1 Isolation, purification and cultivation of bacterial viruses.

2.2 Study of one step growth curve of bacterial viruses.

2.3 Types of bacteriophages, lytic and lysogenic phages (lambda phage)

2.4 Concept of early and late proteins, regulation of transcription in lambda phage. T even, T odd,ϕX174 and M13 phages.

Unit-3: Viral Transmission and Oncoviruses

3.1 Modes of viral transmission: Persistent, non- persistent, vertical and horizontal.

3.2 Replication Assembly, maturation and release of viruses.

3.3 Salient features of viral nucleic acid and the presence of unusual bases e.g., Influenza and Hepatitis B virus, HIV, polio virus, Vaccinia virus, Rabies Virus. TMV, Cauliflower Mosaic Virus.

3.4 Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes.

Unit-4: Antivirals

4.1 Antiviral compounds and their mode of action

4.2 Interferon and their mode of action;

4.3 Viral vaccines; Introduction to use of viral vectors in cloning and expression

4.4 Gene therapy and Gene Editing Tools

Reference Books:

1. M..Pelczar , E.C.S. Chan and N.R. Krieg, Microbiology. Tata McGraw Hill Publishing Co. Ltd., NewDelhi.
2. R.V.Stainier, J.L.Ingraham, M.L .Wheelis and P.R. Painter TheMicrobialWorld. Printice-Hall of India (Pvt.) Ltd., NewDelhi
3. Ellen Strauss, James Strauss, Viruses and Human Disease 2nd Edition. AcademicPress
4. Burrell, C.J., Howard, C.R. and Murphy, F.A., 2016. *Fenner and White's medical virology*. Academic Press.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

1. Assignment/Tutorials
2. Sessional tests
3. Surprise questions during lectures/Class Performance
4. Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-301)	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3
BMB-DS-301.1	3	2	1	2	2	2	2
BMB-DS-301.2	3	2	1	1	2	2	2
BMB-DS-301.3	3	2	2	2	2	2	2
BMB-DS-301.4	3	2	2	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 302 :MYCOLOGY& PHYCOLOGY

Periods/week	Credits		Max. Marks	:200
L: 4	T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs			End Semester Examination	:100

Course Outcomes: The students will be able

BMB-DS-302.1 Toidentify commonly available fungi and algae and their characteristics.
BMB-DS-302.2 To understand the useful and harmful activities of fungi and algae
BMB-DS-302.3 To learn the cultivation techniques of fungi and algae.
BMB-DS-302.4 To understand the use of fungi and algae in different areas.

Unit 1: Mycology: Introduction

1.1 Characteristics, classification and cellular &thallus organization of fungi.
1.2General features, structure, nutrition, reproduction of different fungi group:
- 1.2.1 Phycomycetes
- 1.2.2 Ascomycetes
- 1.2.3 Basidiomycetes
- 1.2.4 Deuteromycetes

1.3 Heterothallism and Para- sexuality.
1.4 Sex hormones in fungi
1.5 Phylogeny of fungi.

Unit 2: Mycology: Classification & Applications

2.1 General features, taxonomic status and economic importance of important fungal genera
- 2.1.1 Mucor
- 2.2.2 Saccharomyces
- 2.2.3 Agaricus
- 2.2.4 Fusarium
- 2.2.5Alternaria,

2.3 General account and importance of lichen.
2.4 Important plant diseases caused by fungi- symptoms, disease cycles and control (Late & Early blight, Black rust, Smut, Wilt and Red rot).
2.5 Applications of fungi
- 2.5.1 Food industry (Flavour& texture, Fermentation, Baking, Organic acids, Enzymes, Myco -proteins)
- 2.5.2 Secondary metabolites (Pharmaceutical preparations)
- 2.5.3 Agriculture (Biofertilizers); Mycotoxins, Biological control(Mycofungicides,Mycoherbicides, Mycoinsecticides).
- 2.5.4 Mushroom andits cultivation.

Unit 3: Phycology: Introduction

3.1 General characteristics,Occurrence, thallus organization of Algae
3.2 Cell structure and components (cell wall, pigment system, reserve food, flagella, eye- spot food reserves and vegetative, asexual and sexual reproduction)
3.3 Classification; criteria and system of Fritsch, and evolutionary classification of Lee
3.4 Significant contributions of important phycologists

Unit 4: Phycology: Classification & Applications

4.1 General features, structure and reproduction and economic importance of :

4.1.1 *Chlamydomonas*, *Chlorella, Diatoms*

4.1.2 *Oscillatoria, Spirulina,*

4.1.3*Anabaena, Nostoc*

4.1.4 *Rivularia and Scytonema.*

4.2 Applications of Algae

4.1.1 Food industry

2.5.2 Agriculture

2.5.3 Nanobiotechnology

2.5.4 Biofuel

2.5.5 Masscultivation of algae as a source of protein.

Text Books/ Reference Books:

1. C. J. Alexopoulus,C. W.Mims and M. Blackwel,2007, Introductory Mycology. John Wiley, New York.
2. R.S. MehrotraandK.R.Aneja, 2015, An Introduction to Mycology. New Age International Press, New Delhi.
3. J. Webster, 1985, Introduction to fungi. Cambridge University Press. Cambridge, U.K.
4. E.A. Bessey, 2015, Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Jhon Webster and R W S Weber, 2007, Introduction to Fungi. Cambridge University Press
6. A. V. S. S. .Sambamurty, 2010,A Textbook of Algae. I.K. International Publishing House Pvt. Limited,
7. H.D. Kumar and H.N. Singh, 1979, A Textbook on Algae (Macmillan international college edition)

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-302)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-302.1	2	2	2	3	2	2	2
BMB-DS-302.2	3	3	2	1	2	2	3
BMB-DS-302.3	3	3	2	2	2	2	2
BMB-DS-302.4	3	3	3	3	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-303: ENVIRONMENTAL MICROBIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course Outcomes:

The students will be able to-

BMB-DS-303.1. understand different types of environments and habitats where microorganisms grow including the microbiomes of the human gut and animal gut.

BMB-DS-303.2. identify the role microorganisms in the environment

BMB-DS-303.3. apply appropriate tools in the identification of microbes in the environment

BMB-DS-303.4. apply the theoretical principles for maintaining sustainable environment

Unit 1 : Microbes and their environmental niches

1.1 Microbial ecosystems: Population, guilds and communities

1.2Microbial Diversity: Terrestrial Environment: Soil profile and soil microflora.

1.3 AquaticEnvironment:Microflora of fresh water and marine habitats

1.4Atmosphere: Aeromicroflora and dispersal of microbes.

1.5Animal Environment: Microbes in/on human body (microbiomics) & animals (ruminants)

1.6Extreme Habitats:Extremophiles:Microbes thriving at high & low temperatures , extreme pH & osmotic pressures, salinity, & low nutrient levels.

1.7 Microbial growth on surfaces

Unit 2 : Investigations in environmental microbiology:

2.1sampling, detection, isolation

2.2 taxonomic and functional annotation and quantification

2.3Microbial sampling: Culture based and culture independent tools

2.4Molecular biology tools: Cloning, amplification, sequencing,Case study

Unit 3: Bioremediation

3.1 Bioremediation and examples, Principles and degradation of common pesticides

3.2 organic (hydrocarbons, oil spills) and inroganic (metals) matter, biosurfactants.

3.3 Acid mine drainage, Enhanced metal recovery

Unit 4: wastewater and Solid waste microbiology

4.1Drinking water microbiology,

4.2Drinking water microbiome and treatment,

4.3Microbial instability ,Water borne microbial diseases

4.4 Landfills, Leachate, Anaerobic degradation phases, Antimicrobial resistance

Text Books/Reference Books:

1. M. T. Madigan;J. M. Martinko and J. Parker,2006,Brock Biology of Microorganisms,13th Edition, Prentice Hall, IntInc Publication.
2. M.J.Alexander,1971 Microbial ecology, 2nd edition, Wiley & Sons, Inc., New York.
3. M.J.Alexander,1977. Introduction to soil microbiology, 2nd edition, Wiley & Sons Inc., NewYork.

4. M.J.Pelczar et al,2009,Microbiology: Concepts and Application, 10th Ed, Tata McGraw Hill Publication,.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BBT-DS-303)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
BBT-DS-303.1	2	2	2	2	2	2	1	3	-	1
BBT-DS-303.2	2	2	2	2	2	2	1	3	-	1
BBT-DS-303.3	3	2	2	2	2	1	1	2	2	2
BBT-DS-303.4	3	2	2	2	2	1	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS 351 : MYCOLOGY & PHYCOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Evaluation	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Course outcomes:The students will be able to

BMB-DS-351.1 identify and classify different fungi and algae.
BMB-DS-351.2learn the cultivation techniques of fungi and algae.
BMB-DS-351.3 understand the isolation, purification and preservation of different fungi and algae
BMB-DS-351.4 discuss the host-pathogeninteraction.

List of Experiments:

1. To preparae Potato DextroseMedium.
2. To study the isolation and identification of common fungi.
3. To study the isolation and identification of common algae.
4. To study the purification and preservation of pure cultures of fungi.
5. To study the purification and preservation of pure cultures of algae.
6. To study the Microflora of polluted soil.
7. To study the host-pathogen interaction.
8. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: Mucor, Saccharomyces, Penicillium, AgaricusandAlternaria,
9. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Chlamydomonas*, *Chlorella, Diatoms,Oscillatoria, Spirulina,Anabaena, NostocRivularia and Scytonema.*
10. To visit local Mushroom cultivation unit.

Text Books/Reference Books:

1. C.J .Alexopoulus, C.W. Mims and M. Blackwel, Introductory Mycology. John Wiley, New York.
2. R.S.Mehrotra andK.R.Aneja An Introduction to Mycology. New Age International Press, New Delhi.
3. Jhon Webster and R. W. S. Weber,2007, Introduction to Fungi. Cambridge University Press
4. A. V. S. S. .Sambamurty,2010, A Textbook of Algae. I.K. International Publishing House Pvt. Limited
5. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international college edition)

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-351)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**
BBT-DS-351.1	2	2	2	2	2	2	1	3	3	3
BBT-DS-351.2	2	2	2	2	2	2	1	3	3	1
BBT-DS-351.3	3	2	2	2	2	1	1	2	2	2
BBT-DS-351.4	3	2	2	2	2	1	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-352: ENVIRONMENTAL MICROBIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Evaluation	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Course outcomes:

BBT-DS-352.1 The students will be able to-
BBT-DS-352.2 Assess the parameters that describe the quality of a given sample
BBT-DS-352.3 Understand the basic enrichment techniques to isolate a specific group of bacteria from soil
BBT-DS-352.4 Evaluate the process and tolerance level of a heavy metals by bacterial isolates

List of Experiments:

1. Assessment of microbiological quality of water.
2. Determination of BOD of wastewatersample.
3. Study the presence of microbial activity by detecting(qualitatively) enzymes (dehydrogenase, amylase, urease) insoil.
4. To isolate bacteria resistant to heavy metals from soil sample.
5. Evaluation of Heavy Metal Tolerance Level (MIC) of bacterial isolates
6. To study the process of metal accumulation by bacteria.
7. Estimation of Heavy metals in soil/ water samples.
8. Isolation of Xenobiotic degrading bacteria from given samples.
9. To detect coliphages in water/ sewage.
10. To visit local ETP unit to observe waste water treatment.

Text/Reference Books:

1. K.R.Aneja,2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
2. J.Cappucinno&N.Sherman, 2014,Microbiology –A Lab manual,11th Edition, Addison Wesley Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Continuous Assessment:

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Course Articulation Matrix

CO Statement (BBT-DS-352)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**
BBT-DS-352.1	2	2	2	2	2	2	1	3	3	1

BBT-DS-352.2	2	2	2	2	2	2	1	3	3	1
BBT-DS-352.3	3	2	2	2	2	1	1	2	2	2
BBT-DS-352.4	3	2	2	2	2	1	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

DTI-300: DESIGN, THINKING AND INNOVATION – I

Periods/week	Credits		
P: 1	1.0	Max. Marks	: 50
		Continuous Assessment	: 50

Pre-requisites: Nil
Course Type: Research & Training

Course Outcomes:
RIC 300.1. To explore different sources for generating ideas for Research.
RIC 300.2. To understand the problem classification based on domain specific resources.
RIC 300.3.To realize the design thinking stages.
RIC 300.4.Topresent critical analysis of literature survey.

Activity 1: Motivation
- 1.1 Divergent thinking and brain storming
- 1.2 Creative process

Activity 2: Introduction to Design Thinking
- 2.1 Empathize Mode
  - 2.1.1 Discussions and deliberations
- 2.2 Define Mode
- 2.3 Ideate Mode
  - 2.3.1Contemporary Relevance.
  - 2.3.2 Tools and techniques for generating ideas
  - 2.3.3 Idea Challenges

Activity 3: Problem Classification
- 3.1 Domain Classification.
- 3.2 Identification of Mentors

Activity 4: Problem identification
- 4.1 Literature survey and option analysis.
- 4.2 Feasibility study.
- 4.3 Formulation of problem statement.
- 4.4Expected Outcome / Model of the problem.
- 4.5 Planning Matrix

Activity5: Presenting the Ideation
- 5.1 Structuring and preparation of PPT
- 5.2 Review on presentation skills and content delivered
- 5.3 Incorporating the review comments.

Course Articulation Matrix:

CO Statement (RIC-300)	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 3
DTI-300.1	2	2	2	3	2	3	2
DTI-300.2	2	3	2	3	3	2	2
DTI-300.3	2	2	2	2	3	2	2
DTI-300.4	1	1		1	2	2	3

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No:	Parameters	Description	Marks	
1.	**Attendance**	Percentage of classes attended by the students	**5**	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task:		**15**
		Judge individual student in the group	**5**	
		Meeting timelines as per activity plan	**10**	
3.	**Literature Review**	Student interaction with faculty mentors	**5**	**15**
		Relevance of the topic	**3**	
		Usage of Scientific Literature Databases. e.g., Scopus/ Web of Science/ etc.	**2**	
		Number of relevant papers / design referred for the given topic	**5**	
4.	**PPT & Report**	Report structure and Slide sequence	**5**	**15**
		Contribution of individual group member towards the presentation and report	**5**	
		Scientific/Technical writing	**5**	
		Max. Marks	**50**	**50**

References:

1. http://nptel.ac.in/courses/121106007/
2. http://public.wsu.edu/~taflinge/research.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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NAAC 'A' Grade University

BHM-MC-004: **QUANTITATIVE APTITUDE**

Periods/week	Credits	Max. Marks	: 100
P:2	AP	Continuous Evaluation	: 50
Duration of Exam: 2 hrs		End Semester Examination(Written)	: 50

Pre-requisites: None
Course Type: HSMC

Course Outcomes:
Students will be able to
BHM-MC-004.1. recognize problems based on arithmetic & number system.
BHM-MC-004.2. solve problems based on verbal reasoning & simplification.
BHM-MC-004.3. calculate the correct answers to the problems within given time.
BHM-MC-004.4. plan their career meticulously by setting their time oriented goals.
BHM-MC-004.5. introspect and enhance their personality.
BHM-MC-004.6.develop cultural sensitivity and communicate respectfully across cultures.

PART – A

Unit 1: Number System 1
1.1 Vedic Mathematics
- 1.1.1 Basic of mathematics
- 1.1.2 Addition and subtraction using Vedic Mathematics
- 1.1.3 Multiplication of two and three numbers.

1.2 Simplification
- 1.2.1 BODMAS rule
- 1.2.2 Fractions and recurring decimals
- 1.2.3 Surds and indices

1.3 Numbers
- 1.3.1 Types of numbers and number tree
- 1.3.2 Divisibility Rule
- 1.3.3 HCF & LCM

Unit 2: Verbal Reasoning 1
2.1 Direction Sense Test
2.2 Blood Relation Test

Unit 3: Arithmetic 1
3.1 Problem on Ages
3.2 Problem on Numbers
3.3 Averages

PART B

Unit 4: Career Planning
4.1 **Career planning Process** - Self Evaluation, Research, Decision Making, Action and Employability

4.2 **Goal Setting:** Relevance, SMART goals, The Dos & Don'ts

Unit 5: Personality Enhancement

5.1 **Emotional Intelligence:** Emotional Self -Awareness, Self- Control, Emotional Management

5.2 **Stress Management:** What is Stress, Types of Stress, Stress Response Example, Vulnerability to Stress, Why do we Stress out, Stress Warning Symbols, Suggestions for Reducing Stress,

5.3 **Time Management:** Setting Priorities, Managing Time, Four Quadrants of Time Management

5.4. **Team Building:** Definition –Team, Characteristics of effective Teams, Competence, Clear and Compelling goal, Supportive Environment, Alignment, Designing the Team, Identifying Roles and Responsibilities, Determining Reward, Troubleshooting Guide, Good Team member

Unit 6: Effective Communication

6.1 **Courtesy in Communication:** Being Polite, Self -Discipline, Respecting Others and understanding other's perspective in communication

6.2 **Inter cultural Communication:** Breaking Stereotypes, Diversity Inclusion and Cultural Sensivity

Text Books/Reference Books:

1. R. S. Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company Pvt Ltd, Edition
2. R. S. Aggarwal,2018, A Modern Approach to Verbal& Non Verbal Reasoning: S Chand & Company Pvt. Ltd, Edition
3. M. A. Griffin,College to Career: The Student Guide to Career and Life Navigation
4. A.Gutierez, Effective Communication in the Workplace.

Instructions for paper setting: Fifty MCQ will be set in total. TwentyFiveMCQwillbe set from Part A and Twenty Five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO (BHM-MC-004)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BHM-MC-004.1	1	-	-	2	-	-	-
BHM-MC-004.2	1	-	-	-	-	-	-
BHM-MC-004.3	1	-	-	1	-	-	-
BHM-MC-004.4	-	-	1	-	-	-	1
BHM-MC-004.5	-	-	1	-	-	-	1
BHM-MC-004.6	-	-	1	-	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 321 :PLANT PATHOLOGY & DISEASE MANAGEMENT

Periods/week	Credits	Max. Marks	: 200
L: 4 T: 0	4	Continuous Assessment	: 100
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 100	

Course Outcomes: The students will be able to

BMB-DS-321.1 Understand the basic concepts of plant pathology & disease management

BMB-DS-321.2 Describe about the important plant diseases, their etiology, salient characteristics and control measures

BMB-DS-321.3 Differentiate the cultivation techniques of fungi and algae.

BMB-DS-321.4 Develop the skills to identify and analyze the diseased plant samples in the laboratory

PART-A

Unit 1: Plant Pathology: Introduction

1.1 Concept of plant disease- definitions of disease

1.2Disease cycle &pathogenicity,Symptoms associated with microbial plant diseases

1.3 Types of plant pathogens, Economic losses and social impact of plant diseases.

1.4Significant landmarks in the field of plant pathology

1.5 Contributions of eminent Indianplant pathologists.

Unit 2: Host parasite interaction

2.1 Infection, invasion, colonization, dissemination of pathogens and perennation.

2.2Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle &disease pyramid, forecasting of plant diseases and its relevance in Indian context.

2.3 Microbial Pathogenicity**:** Virulence factors of pathogens: enzymes,toxins (hostspecificandnon-s pecific)growthregulators,virulencefactorsin

2.4 Genetics of Plant Disease: Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

PART-B

Unit 3: Disease Management: Introduction

3.1 Principles & practices involved in the management of plant diseases by different methods,

- 3.1.1regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material.
- 3.1.2Cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches
- 3.1.3 chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.
- 3.1.4 biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plant

3.2 genetic engineering of disease resistant plants- with plant derived genes and pathogenderivedGenes

3.3 Defense Mechanisms in Plant:inducible structural defenses, inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics,quinones,oxidative bursts]

Unit 4: Disease Management: Examples

4.1 Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control.

White rust of crucifers-*Albugocandida;*
Downy mildew of onion-Peronospora destructor
Late blight of potato –*Phytophthorainfestans;*
Powdery mildew of wheat – *Erysiphegraminis*
Ergot of rye –*Clavicepspurpurea;*
Black stem rust of wheat – *Pucciniagraministritici*
Loose smut of wheat –*Ustilagonuda;*
Wilt of tomato - *Fusariumoxysporumf.sp. lycopersici*
Red rot of sugarcane –*Colletotrichumfalcatum;*
Early blight of potato –*Alternariasolani;*
Angular leaf spot of cotton,bacterial leaf blight of rice, crowngalls, bacterial cankers of citrus; Aster yellow, citrus stubborn; Papaya ring spot,tomatoyellow leaf curl,banana bunchy top

Text Books/ Reference Books:

1. George NicholasAgrios,2005, Plant Pathology, , .Elsevier Science Publishing Co Inc
2. R S Mehrotraand Ashok Agrawal, 2006, Plant Pathology. Tata McGrawHill ,6th reprint.
3. HG. Hewitt, 1998. Fungicides in Crop Protection. CABI, Wallington.
4. WE. Fry 1982. Principles of Plant Disease Management. Academic Press, New York.
5. Singh RS. 1998. Plant Diseases. 7th Ed. Oxford & IBH, New Delhi.
6. U. S. Singh, A. N. Mukhopadhyay, J. Kumar and H. S. Chaube HS, 1992, Plant Diseases of International Importance. Vol. I. Diseases of Cereals and Pulses. Prentice Hall, Englewood Cliffs, New Jersey.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BBT-DS-321)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**
BBT-DS-321.1	2	2	2	2	2	2	1	3	3	1
BBT-DS-321.2	2	2	2	2	2	2	1	3	3	1
BBT-DS-321.3	3	2	2	2	2	1	1	2	2	2
BBT-DS-321.4	3	2	2	2	2	1	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 353 : PLANT PATHOLOGY & DISEASE MANAGEMENT LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course outcomes:The students will be able to

BMB-DS-353.1 identify and classify different fungal, bacterial & viral diseases.
BMB-DS-353.2 learn the cultivation techniques of fungal, bacterial pathogens.
BMB-DS-353.3 compare the chemical and biological control methods
BMB-DS-353.4 compare the changes in the protein profile in response to a pathogen attack

List of Experiments:

1. To demonstrate the symptoms for identification of different fungal, bacterial &viraldiseases in the laboratory.
2. To demonstrate the symptoms for identification of different fungal, bacterial &viraldiseases in the agricultural fields.
3. To study important diseases of crop plants by cutting sections of infected plant material- *Fusarium, Alternaria*
4. To demonstrate Koch's postulates in fungal, bacterial &viralplant pathogens.
5. To study compatability among different biocontrol agents in the laboratory.
6. To study the mechanism of biocontrol in vitro by dual culture technique.
7. To compare the antimicrobial activity of different antibiotics in vitro by disc diffusion technique.
8. To compare the antimicrobial activity of different plant extracts in vitro by food poisoned technique.
9. To study the protein profiling in healthy and infected plant.
10. To visit local Biofertilizer/biopesticide production unit.

Text Books/Reference Books:

1. EldorA.Paul. SoilMicrobiology. Ecology and Biochemistry.VIEdition:Academic Press, (2007).
2. EugeneL.Madsen.EnvironmentalMicrobiology:FromGenomestoBiogeochemistry. IEdition,Wiley-BlackwellPublishing. (2008).
3. K. S. Bilgrami, H. C. Dube. A textbook of modern pathology. 6thEdition,VaniEducational Books, a division of Vikas,(1984).
4. Plant Pathology.Elsevier Science Publishing Co Inc 2005.George NicholasAgrios
5. K.R. Aneja, Experiments in Microbiology, Plant Pathology and Biotechnology .New Age Publications2017

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-353)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3	PSO 4
BMB-DS-353.1	3	3	3	2	1	2	3	1
BMB-DS-353.2	3	3	1	1	3	1	3	2
BMB-DS-353.3	3	3	1	2	1	3	2	1
BMB-DS-353.4	3	3	1	2	1	3	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-322: PHARMACEUTICAL MICROBIOLOGY

Periods/week Credits	Max. Marks: 200
L: 4 T: 0 4	Continuous Assessment : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination: 100

Course Outcomes: The students will be able to

BMB-DS-322.1 Understand basics of antimicrobial agents including biopharmaceutics, their chemical nature, and mechanism of action

BMB-DS-322.2 evaluate the formulations involving different antimicrobials along with their stability and acquisition of resistance acquired by microbes

BMB-DS-322.3 explain the key microbiological aspects related to the production of pharmaceutical product

BMB-DS-322.4 compare the different microbiological assays and safety profile of dfferent drugs including biopharmaceutics

Unit-1: **Introduction to chemotherapeutic agents: Antibiotics and Synthetic antimicrobial agents**

1.1 Antibiotic and Synthetic antimicrobial agents
1.2 Mechanism of action of antibiotics:Inhibition of cell wall synthesis,nucleic acid and protein synthesis.
1.3 β-lactam, aminoglycosides, tetracyclines, macrolides.
1.4 Antifungal antibiotics:Griseofulvin.Antiviral drugs: Amantidines;Nucleoside analogues, interferons.
1.5 Peptide antibiotics. Synthetic antibiotics: Sulphonamides Chloramphenicol; Quinolone
1.6 Bacterial resistance to antibiotics;Penetration of antimicrobial agents (cellular permeability barrier, cellular transport system and drug diffusion).

Unit-2 : Classification and mode of action of disinfectants.

2.1 Overview of Antiseptics and Disinfectants
2.2 Factors influencing disinfection, antiseptics and their evaluation for bacteriostatic and bactericidal actions
2.3Bacterial Resistance to Antiseptics and Disinfectants
2.4 Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Unit-3 : Sterilization and Microbial spoilage of pharma products

3.1 Types of spoilage,
3.2 Factors affecting the microbial spoilage of pharmaceutical products,
3.3Sources and types of microbial contaminants
3.4 Assessment of microbial contamination and spoilage.
3.5 Preservation of pharmaceutical products using antimicrobial agents,
3.6 Evaluation of microbial stability of formulations.Growth of animal cells in culture
3.6 General procedure for cell culture, Primary, established and trans- formed cell cultures.
3.7 Application of cell cultures in pharmaceutical industry and research.

Unit-4 :Microbiological Assay and Their Application to Pharmaceutical Industry

4.1Principles and methods of different microbiological assay.
4.2 Methods for standardization of antibiotics, vitamins and amino acids.

4.3 Assessment of a new antibiotic and testing of antimicrobial activity of anew substance.
4.4 Safety profile of drugs (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and -neurotoxicity) 4.5 Toxicological evaluation of drug: LD50, Acute, subacute and chronic toxicity ;Mutagenecity (Ames test, micronucleus test)
4.5 Carcinogenicity and Teratogenecity
4.6 Overview of Biopharmaceutics
4.6 Methods of Rapid Microbiological Assay and Their Application to Pharmaceutical and Medical Device Fabrication

Text Books/Reference Books:

1. S.P Denyer, N.A. Hodges, and S.P. Gorman, eds., 2008. *Hugo and Russell's pharmaceutical microbiology*. John Wiley & Sons.
2. R.Y.Stainier, J.L.Ingraham,M.L.WheelisandP.R.Painter, 1992,General Microbiology,5thEdition,McMillan Publications.
3. T.Sandle, 2015. *Pharmaceutical microbiology: essentials for quality assurance and quality control*. Woodhead Publishing.
4. S. Anderson, R. Huss, R., R.Summers and K. Wiedenmayer, 2012. *Managing pharmaceuticals in international health*. Birkhäuser.
5. S.K. Jain, and V. Soni, 2011. *Bentley's Textbook of Pharmaceutics-E-Book*. Elsevier health sciences.

CO Statement (BBT-DS-322)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BBT-DS-322.1	2	2	-	-	3	1	1
BBT-DS-322.2	2	2	-	-	3	1	1
BBT-DS-322.3	2	2	-	-	3	1	2
BBT-DS-322.4	2	2	-	-	3	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-354: PHARMACEUTICAL MICROBIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
P: 3	1.5	Continuous Evaluation	: 50
Duration of Ext. Exam: 3 Hrs		End Semester Examination: 50	

Course outcomes:
The students will be able to:
BBT-DS-354.1 Develop practical skills for testing pharmaceutical products for sterility
BBT-DS-354.2 Evaluate pyrogenicity testing using different methods
BBT-DS-354.3 Understand the use of bioinformatic tools in pharmaceutics

List of Experiments:
1. Microbial Examination of sterile and Non Sterile Products
2. Bacterial Endotoxin Testing by Gel Clot Method
3. Test for Confirmation of Labeled LAL Reagent Sensitivity (LAL Test)
4. Antibiotic Potency Testing
5. Bioburden Estimation for Medical Devices
6. Determination of D value, Z value for heat sterilization in pharmaceuticals.
7. Chemical / Microbiological methods for the determination of Penicillin, Streptomycin, Griesofulvin
8.Prediction of binding site of macromolecules using Bioinformatic tools

Text Books/Reference Books:

1. D. Roesti, and M. Goverde, eds., 2019. Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-sterile Manufacturing. John Wiley & Sons.
2. K.R.Aneja,2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
3. J.Cappucinno&N.Sherman, 2014,Microbiology –A Lab manual,11th Edition, Addison Wesley Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-354)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3	PSO 4
BMB-DS-354.1	3	3	3	2	1	2	3	1
BMB-DS-354.2	3	3	1	1	3	1	3	2
BMB-DS-354.3	3	3	1	2	1	3	2	1

4th Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-401: MOLECULAR BIOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Pre-requisites: Cell Biology
Course Type: Core

Course Outcomes:

The students will be able to-

BMB-DS-401.1 recognize the basic structure and organization of genetic material in prokaryotes and eukaryotes.

BMB-DS-401.2 explain the processes of replication, transcription, translation, and regulation.

BMB-DS-401.3 analyse the structure, organization, function and regulation of genetic elements.

BMB-DS-401.4 compare the complex processes involved in function and regulation of DNA, RNA and protein.

Unit 1: DNA Structure and Replication

1.1 DNA bending, DNA super coiling
1.2 DNA protein interactions
1.3 Packaging in nucleosomes; Chromosome organization in cell
1.4 Denaturation and renaturation of DNA - Tm values; Cot curves analysis,C-value paradox
1.5 Mechanism of DNA replication in prokaryotes and eukaryotes

Unit2: Transcription

2.1 Mechanism in prokaryotes and eukaryotes
2.2 RNA polymerase, sigma factor
2.3 Post transcriptional processing -5' end capping and 3' polyadenylation
2.4 RNA splicing: intron and exon splicing, spliceosome, lariat formation

Unit3: Operon Model

3.1 Regulation of gene expression in prokaryotes
3.2 Inducible systems- Lactose operon
3.3 Repressible Systems-Tryptophan operon
3.4 Regulation of gene expression in eukaryotes zinc finger motifs, helix loop helix, leucine zippers.

Unit4: Protein Synthesis

4.1 Component of Protein synthesis-ribosomes, tRNA, mRNA, rRNA
4.2 Mechanism of Protein synthesis
4.3 Post translational modification
4.4 Transport of protein
4.5 Degradation of protein

Text Books/Reference Books:

1. R. R. Sinden, 2006, DNA structure and function,12thEdition,Academic Press Publication.
2. B.Lewin, 2017,Genes XII,12thEdition,Oxford University Press Publication.
3. B. Alberts, J.D.Watson, 2017, Molecular Cell Biology,6th Edition, Garland Publication.

4. Cooper, 2015,The cell – a molecular approach,7th Edition,A.S.M.Press Publication,.
5. G. Karp,2013, Cell & Molecular biology , Concepts & experiments,8th Edition,John Wiley & Sons Publication.
6. T.A.Brown, 2016, Genomes: 7th Edition,John Wiley & Sons Pvt. Ltd Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-401)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-401.1	2	2	-	-	2	2	1
BMB-DS-401.2	3	3	2	1	2	2	1
BMB-DS-401.3	3	3	2	2	2	2	2
BMB-DS-401.4	3	3	3	3	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-402 MICROBIAL GENETICS

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Prerequisites: Microbial Genetics
Course Type: Core

Course Outcomes:
The students will be able to-

BMB-DS-402.1 Describe the central dogma and the DNA information pathways, Introducing synthetic biology.

BMB-DS-402.2 Understand the Genetics of Microbial Communication, Environmental Stress Response and microbial defense.

BMB-DS-402.3 Understand the various mechanisms of Microbial Genetic Exchange and Creating genetic maps

BMB-DS-402.4 Apply microbial and meta-genomics in animal and plant health and disease

Unit 1. Prokaryotic Information Pathways

1.1 Mutations
1.2 DNA repair Mechanisms,
1.3 Bacteriophage genetics
1.4 Restriction-modification systems, Recombination,
1.5 Molecular Applications – Synthetic biology

Unit 2. Microbial Genetic Response

2.1 Genetics of Quorum Sensing
2.2 Stress Shock
2.3 Bacterial Motility
2.4 Two-Component Regulation
2.5 Genetics of bacterial defense system

Unit 3. Genetic Exchange

3.1 Bacterial Transposons
3.2 Transformation
3.3 conjugation
3.4 Transduction
3.5 Yeast genetics
3.6 Neurospora genetics

Unit 4 Microbial Genomics

4.1 Phylogeny
4.2 Metagenomics
4.3 Comparative Genomics
4.4Horizontal Gene Transfer

4.5Human Microbiome

Text Books/Reference Books:

1. U.N. Streips, and R.E. Yasbin,2004. *Modern microbial genetics*. John Wiley & Sons.
2. Maloy Stanly, R., R. Maloy Stanly, E. Cronan John, and Freifelder David. *Microbial genetics*, 2006, Narosa Publishing House
3. V.A.Saunders, 2012. Microbial genetics applied to biotechnology:: principles and techniques of gene transfer and manipulation. Springer Science & Business Media.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-402)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-402.1	2	-	-	-	-	-	-
BMB-DS-402.2	2	2	1	-	-	3	1
BMB-DS-402.3	2	2	1	1	-	2	1
BMB-DS-402.4	2	2	-	2	1	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-403: INDUSTRIAL MICROBIOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The student will be able to

BMB-DS-403.1: describe a large number of substrates that are used for the industrial fermentation processes.

BMB-DS-403.2:developed an understanding of different types of reactors or fermenters which are used for laboratory, pilot and industrial scale fermentations and their processes parameters.

BMB-DS-403.3:develop a clear insight of various industrial production of valuable products at commercial level

BMB-DS-403.4: decide which techniques are applicable in bioprocessing and purification of particular products

UNIT 1: Introduction of Industrial Microbiology

1.1 Brief history and developments in industrial microbiology
1.2 Sources of industrially important microbes and methods for their isolation
1.3 Preservation methods and maintenance of industrial strains
1.4 Improvement of industrial microorganisms using classical methods and recombinant DNA approaches.
1.5 Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

UNIT 2: Fermenter their Types and Uses

2.1Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations, batch, fed-batch (e.g. baker's yeast) and continuous fermentations
2.2 Components of a typical bio-reactor
2.3 Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters,
2.4 Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration
2.5 Role of Microbes in Medicine and textile industry.

UNIT 3: Production of Microbial Metabolites

3.1 Industrial production of alcohol (ethanol and butanol)
3.2 Industrial production of organic acid (citric acid and acetic acid)
3.3 Industrial production of enzymes (amylases, proteases, cellulases)
3.4 Industrial production of Penicillin and streptomycin
3.5 Microbial cells as food. SCP and mushroom

UNIT 4: Downstream Techniques and Fermentation Economics

4.1 Down-stream processing; Cell disruption, filtration
4.2 Centrifugation, solvent extraction,precipitation,
4.3 Lyophilization and spray drying
4.4Introduction to fermentation economics, Production decisions
4.5 Cost and investment decisions, Market potential.

Text Books/ Reference Books:

1. H.B Richard, J..E Davies and L.D.2010,Anual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press.
2. F.Daniel.2008, IndustrialBioseperation: Principles and practice. 1st edition, WileyBlackwell .
3. R. G. Prescott and S.Dunn.1999. Industrial Microbiology. CBS Publishers.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual and will be compulsory to attempt. Rest of the six questions will cover entire syllabus and consist of two questions from each unit. Student needs to attempt four more questions, selecting at least one question from each unit. Each question will be of 20 marks.

Distribution of Continuous Assessment

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-403)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-403.1	1	2	3	1	3	1	2
BMB-DS-403.2	3	2	-	2	3	2	3
BMB-DS-403.3	3	1	2	1	3	1	3
BMB-DS-403.4	2	-	3	1	3	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-451: MOLECULAR BIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course Outcomes:

The students will be able to:
BMB-DS-451.1 describe the techniques involved in molecular biology
BMB-DS-451.2 demonstrate skills in isolation, quantification and purification of DNA
BMB-DS-451.3 apply the molecular biology techniques for novel applications

List of Experiments:

1. Isolation of prokaryotic DNA
2. Isolation of DNA from Yeast
3. Isolation of DNA from Plant cells.
4. Isolation of plasmid DNA
5. Molecular weight characterization of a given DNA sample using Agarose Gel Electrophoresis
6. To perform the technique of Gel Extraction of DNA.
7. To study and perform the basic scheme of Polymerase Chain Reaction
8. To study the technique of SDS-PAGE
9. To study and perform the technique of Restriction mapping
10. To study DNA sequencing Data Analysis.

Text/ Reference Books:

1. J. Sambrook and D.W. Russell,2013, Molecular Cloning- a laboratory manual,4th Edition,Cold Spring Harbor Laboratory Press Publication.

Distribution of Continuous Assessment

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Course Articulation Matrix

CO Statement (BMB-DS-451)	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3
BMB-DS-451.1	2	2	2	1	2	2	2
BMB-DS-451.2	2	2	2	1	2	2	2
BMB-DS-451.3	2	2	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-452 : INDUSTRIAL MICROBIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course outcomes:

BMB-DS-452.1: The students will learn about the isolation and identification of industrially important microorganisms from different sources.

BMB-DS-452.2: The students will observe the growth pattern of Bacteria and Fungi.

BMB-DS-452.3:The students will be able to compare antibiotic producing microbes and antibiotic resistant microbes and also learn to screen mutants.

BMB-DS-452.3:The students will be able to determine antimicrobial spectrum of isolated antibiotic producing microorganism

List of Experiments:

1. Isolation and identification of industrially important fungi.
2. To plot a growth a growth curve of the given bacterial culture.
3. To plot a growth a growth curve of yeast culture.
4. Isolation of antibiotic resistant mutants by replica plate technique.
5. Isolation of antibiotic resistant mutants by gradient plate technique.
6. Isolation of UV induced auxotrophic mutants by replica plate technique.
7. Isolation of antibiotic producing microorganisms from soil.
8. To determine the antimicrobial spectrum of the isolated antibiotic producing microorganism
9. To perform Kirby-Bauer antimicrobial susceptibility test.
10. Industrial visit (to study the role of yeast in baking industry).

Text Books/ Reference Books:

1. Microbiology lab. Manual: Cappuccino J.&Sheeman N., Addison Wesley Publication, California.(2011)
2. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill. (1986)
3. Willey,Sherwood,Woolverton. Prescott,Harley, and Klein's Microbiology McGraw-Hill publication (2008)
4. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings. (2007)
5. JACQUELYN G. BLACK. Microbiology Principles and explorations. JOHN WILEY & SONS, INC (2002)

Distribution of Continuous Assessment

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Course Articulation Matrix

CO Statement BMB-DS-452	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-452.1	3	3	2	1	1	3	3
BMB-DS-452.2	2	3	-	1	2	3	2
BMB-DS-452.3	3	2	3	3	3	2	3
BMB-DS-452.4	2	3	-	1	3	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956**)**

DTI-400: Design, Thinking and Innovation – II

Periods/week	Credits		
		Max. Marks	: 50
P: 1	1.0	Continuous Assessment	: 50

Pre-requisites: DTI-300: Design, Thinking and Innovation – I
Course Type: Research & Training

Course Outcomes:

RIC 400.1. To understand the research methodologies/approaches/techniques used in the literature
RIC 400.2. To formulate the experimental procedures / algorithms based on research methodology
RIC 400.3.To develop prototype by experiment / simulation.
RIC 400.4.To analyze the recorded data / output.

Activity 1: Methodology Study & Matrix design.

1.1.Analysis of different approach/methodology adopted by various researchers
1.2. Comparative analysis
1.3. Prospective Design.

Activity 2: Design of experiments

2.1 Finalization of experimental procedure / algorithm design.
2.2 Procurement of materials / Hardware and Software.
2.3. Develop experimental setup / design

Activity 3: Execution of experiments/simulations

3.1. Conduct experiments/ build prototype.
3.2. Modification of the experimental set-up / algorithm.

Activity 4:

4.1 Tabulating and analyzingdata / output.
4.2 Assessment of the output with earlier published work / product
4.3 Interpretation and presentation of the results / outcome.

Course Articulation Matrix:

CO Statement (RIC-400)	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2	PSO 3
DTI-400.1	3	3	2	3	3	3	3
DTI-400.2	3	3	2	3	3	3	3
DTI-400.3	3	3	3	3	3	3	3
DTI-400.4	2	2	2	3	2	2	3

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	Marks
1.	**Attendance**	Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task: Judge individual student in the group Meeting timelines as per lesson plan	**15**
3.	**Experimental Setup / Design**	Assessment of experimental set up / design Evaluation of result / outcome. Validation of results. Novelty / Relevance of work.	**20**
4.	**Structuring and presentation**	Structuring and presentation Group presentation with individual contribution	**10**

References:

1. http://www.sciencedirect.com/
2. https://www.ncbi.nlm.nih.gov/pubmed
3. https://www.elsevier.com/books-and-journals
4. https://www.plos.org/
5. https://www.deepdyve.com/
6. http://ieeexplore.ieee.org/Xplore/home.jsp
7. https://www.researchgate.net/
8. https://www.science.gov/
9. https://scholar.google.co.in/
10. http://www.popsci.com/

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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BHM-MC-006: QUANTITATIVE APTITUDE & PERSONALITY DEVELOPMENT I

Periods/week Credits	Max. Marks : 100
P:2 AP	Continuous Evaluation : 50
Duration of Exam: 2hrs	End Semester Examination(Written): 50

Course Outcomes:

Students will be able to

BHM-MC-006.1. recognize& solve problems based on non-verbal reasoning.
BHM-MC-006.2. solve complex problems based on arithmetic reasoning.
BHM-MC-006.3. apply short tricks on complex problems of verbal reasoning.
BHM-MC-006.4. apply correct usage of grammar in communication.
BHM-MC-006.5. enhance their vocabulary and use it in day to day life.
BHM-MC-006.6. develop speed reading & writing skills.

Unit 1: Arithmetic II

1.1 Percentages
1.2 Ratio & Proportion
- 1.2.1. Proportionality
- 1.2.2. Variations
- 1.2.3 Partnership

1.3 Profit & Loss
- 1.3.1. Basic terminology & Formulae
- 1.3.2. Error in Weights
- 1.3.3. Marked Price and Discounts

1.4Time & Work
- 1.4.1. Time and Work, Chain Rule
- 1.4.1. Work & Wages
- 1.4.2. Pipes & Cisterns

1.5 Mixtures &Alligations

Unit 2: Verbal Reasoning 2

- 2.1 Syllogism
- 2.2 Ranking
- 2.3 Coding-Decoding
- 2.4Inequalities and Mathematical Operations

Unit 3: Non Verbal Reasoning

- 3.1 Pictorial Series
- 3.2 Missing Values
- 3.3 Analogy and Images

Unit 4: Communication Accuracy

- 4.1 Relevance of Verbal Ability and preparatory guidelines
- 4.2 Functional Grammar – Subject Verb Agreement
- 4.3 Tenses – Perfect, Simple, Continuous

4.4 Common Errors and rectification

Unit 5: Word Power Building Skills

5.1 Words: Antonyms, Synonyms, Verbal Analogies
5.2 Compound words: Homophones, Homonyms, Word Families
5.3 Root Word Technique for Prefixes & Suffixes
5.4: Word Power: 7 Tips for Learning New Words
5.5 Practice Vocabulary Exercises

Unit 6: Reading & Writing Skills

6.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading
6.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed
6.3 Practice Exercises: Short & Medium Passages3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing
6.4 Sentences, Phrases, Types of Sentences, Parts of Sentences
6.5 Paragraph Writing: Construction, Linkage & Cohesion

Text Books/Reference Books:

1. R. S. Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations, S Chand & Company Pvt. Ltd.
2. R. S. Aggarwal, 2018, A Modern Approach to Verbal& Non Verbal Reasoning, S Chand & Company Pvt Ltd.
3. P.A. Anand, Verbal Ability and Reasoning for Competitive Examinations. Wiley

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO (BHM-MC-006)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BHM-MC-006.1	1	-	-	-	-	-	-
BHM-MC-006.2	1	-	-	2	-	-	-
BHM-MC-006.3	1	-	-	-	-	-	-
BHM-MC-006.4	1	-	-	1	1	-	2
BHM-MC-006.5	1	-	-	1	1	1	2
BHM-MC-006.6	1	2	-	1	1	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-421: ADVANCED INSTRUMENTATION: PRINCIPLES AND APPLICATIONS

Periods/week Credits	Max. Marks : 200
L: 4 T: 0 4	Continuous Assessment : 100
Duration of Ext. Exam: 3 Hrs	End Semester Examination:100

Course Outcomes:

The students will beable to-

BMB-DS-421.1 identify the application of advanced bioanalytical technique for identification and separationof microbes and their products.

BMB-DS-421.2 perform qualitative and quantitative analysis of microbes and their products after their isolation.

BMB-DS-421.3 evaluate and trouble shoot the problems commonly encountered during bioanalysis.

BMB-DS-421.4 design and integrate different techniques with upstream and downstream biotechnological processes.

Unit 1: Advanced Microscopic Techniques

1.1 Phase Contrast microscopy
1.2 Fluorescence microscopy
1.3 Scanning Electron microscopy
1.4 Transmission Electron microscopy
1.5 Confocal Microscopy

Unit 2: Advanced Separation Techniques

1.1 Differential centrifugation- Sub-cellular Fractionation
1.2 Density Gradient centrifugation
1.3 Principles of Column Chromatography
1.4 High Pressure Liquid Chromatography (HPLC)
1.5 Gas Chromatography (GC)

Unit 3: ElectrophoreticTechniques

1.1 Agarose Gel Electrophoresis
1.2 SDS-PAGE
1.3 Immuno-electrophoresis
1.4 Isoelectric Focusing
1.5 Two-dimensional gel electrophoresis

Unit 4: Spectroscopy and Radioisotope Techniques

1.1 Colorimetry and UV- VIS spectroscopy
1.2 X-ray spectroscopy
1.3 Spectrofluorimetry
1.4 Infra Red spectroscopy
1.5 Auto-radiography
1.6 Radio-immunoassay

Text Books/Reference Books:

1. K. Wilson and J. Walker ,Principles and techniques of Practical Biochemistry,2000, 5th Edition, Cambridge University Press Publication.
2. D. Friefelder, Physical Biochemistry, 12th Edition, W. H.H Freeman and company Publication
3. Separation and Purification Techniques in Biotechnology:, Standard Publishers (2005). 1st Edition
4. Frederick J. Dechow, Physical Biochemistry: K. E. Vanholde ,1999, Prentice Hall Inc. Publication,
5. Robert. D. Braun ,Introduction to Instrumental Analysis,2012, 2nd Edition, McGraw Hill International Edition, Chemistry Series Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Course Articulation Matrix

CO Statement (BMB-DS-421)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-421.1	3	3	1	3	3	3	3
BMB-DS-421.2	3	3	1	3	3	3	3
BMB-DS-421.3	3	3	2	3	3	3	3
BMB-DS-421.4	3	3	2	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-453: ADVANCED INSTRUMENTATION LAB

Periods/week Credits	Max. Marks :100
P: 2 1.5	Continuous Assessment : 50
Duration of Ext. Exam: 3 Hrs	End Semester Examination:50

Pre-requisites: Knowledge of 10+2 Science
Course Type: Core

Course outcomes:

The students will be able to-
BMB-DS-453.1 identify cellular structure and components through various techniques.
BMB-DS-453.2 separate microbial cells and biomoleculesusing separation techniques.
BMB-DS-453.3 analyze microbes and microbial products using advanced analyses.
BMB-DS-453.4 combine various techniques for complete qualitative and quantitative characterization of microbes and microbial products.

List of Experiments:
1. To study fluorescent micrographs to visualize bacterial cells.
2. Study of SEM images and anatomical interpretation of plant tissue.
3. Study of TEM images and anatomical interpretation of plant tissue.
4. To isolate microbial cells using density gradient centrifugation technique.
5. To purify microbial enzyme/ protein by ion exchange chromatography.
6. To determination the molecular weight of protein by gel filtration.
7. To purify protein by affinity chromatography.
8. To separate and identify proteins by SDS-PAGE.
9. To determine the molar extinction coefficient of microbial product.
10. To determine the absorption maxima of a microbial product.

Reference Books:

1. Principles & Techniques of Practical Biochemistry: K.Wilson&J.Walker, Cambridge University Press Publication, Cambridge.
2. Introductory Practical Biochemistry: S.K.Sawhney&Randhir Singh, NarosaPublising House, New Delhi.
3. An introduction to Practical Biochemistry: David T. Plummer, McGraw Hill Book Company Publication, U.K.
4. Biochemistry Laboratory: Boyer, Pearsoned Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-453)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-453.1	3	3	1	3	3	3	3
BMB-DS-453.2	3	3	1	3	3	3	3
BMB-DS-453.3	3	3	2	3	3	3	3
BMB-DS-453.4	3	3	2	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-422: VETERINARY MICROBIOLOGY

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 0	3	Continuous Assessment	: 100
Duration of Examination: 3 Hrs		End Semester Examination	: 100

Course Outcomes:

The student will be able to

BMB-DS-422.1 : understand the history and scope of veterinary microbiology and classification and structure and normal flora in animals.

BMB-DS-422.2: identify the common type of bacterial infection in animal and their management

BMB-DS-422.3 examine the fungal infections, culture techniques that could affect the animals

BMB-DS-422.4: design the strategy for viral infection identification and treatment based on the knowledge about the symptoms

Unit1: Introduction to VeterinaryMicrobiology

1.1 Developmentalhistory and scope of Veterinary Microbiology
1.2 Unicellular organisms- Prokaryotes and Eukaryotes: Structure and function
1.3 Normal Flora of Animal
1.4 Infections and their typesToxigenicity
1.5 Host -Pathogen Interactions

Unit 2: Common Bacterial Diseases and their Management in Animals
(Study of following animalbacterial diseases with respect to etiology, symptoms, mode of transmission, prophylaxis and control)

2.1 Anthrax,
2.2 Brucellosis
2.3 Tetanous
2.4 Listeriosis:
2.5 *Toxoplasmosis*
2.6 Leptospirosis

Unit 3: Mycosis and Protozoal Infections

3.1Superficial and subcutaneous mycoses: Tinea infection, Zygomycosis
3.2 Systemic mycoses: Histoplasmosis,Blastomycosis
3.3 Opportunistic mycoses: Candidiasis,cryptococcus, Aspergillosis
3.4 Structure and Reproduction of Important Protozoans- Leishmania, Trypanosoma and Plasmodium.
3.5 Intestinal helminthsinfections:Nematodes , Trematodes, Cestodes

Unit 4: Viral Infections in Animals and their Management
(Study of following Animal Viral Diseases with Respect to Etiology, Symptoms, Mode of Transmission, Prophylaxis and Control)

4.1 Kyasanur Forest Disease
4.2 Swine flu, Bird flu
4.3 Animal Coronavirus,
4.4 Rabies

4.5 Nipah Virus Infection

Text Books/ Reference Books:

1.P. J. Quinn, B. K. Markey, F. C. Leonard, P. Hartigan, S. Fanning, E. S. Fitzpatrick ,1996.Veterinary Microbiology and Microbial Disease, 2nd Edition Willey Publication.
2. S.N.Sharma.S.C.Adlakha.Textbook of Veterinary Microbiology.1996.Vikas Publicaing House.
3. R.Ananthanarayan and CKJ Paniker. 2005. Textbook of Microbiology. 7th Edition.University Press Publication.
3.G.F.Brooks,K.C. Carroll, J.S.Butel and S.A.Morse. M.Jawetz, and S.Adelberg,2007. Medical R Microbiology.24th edition. McGraw Hill Publication
4.Goering, H.Dockrell ,M. Zuckerman and D.M. Wakelin ,2007. Medical microbiology.4th edition.Elsevier.

Websites:

http://unaab.edu.ng/funaab-ocw/opencourseware/INTRODUCTORY%20VETERINARY%20MICROBIOLOGY%20AND%20MYCOLOGY.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual and will be compulsory to attempt. Rest of the six questions will cover entire syllabus and consist of two questions from each unit. Student needs to attempt four more questions, selecting at least one question from each unit. Each question will be of 20 marks.

Distribution of Continuous Assessment

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement BMB-DS-422	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-422.1	1	-	3	2	3	1	-
BMB-DS-422.2	3	2	-	1	2	3	1
BMB-DS-422.3	3	1	2	-	3	-	2
BMB-DS-422.4	2	3	3	2	3	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-454: VETERINARY MICROBIOLOGY LAB

Periods/week Credits	Max. Marks : 100
P: 3 1.5	Continuous Assessment : 50
Duration of Examination: 3 Hrs	End Semester Examination : 50

Course outcomes:

BMB-DS-454.1: The students will learn about the isolation and identification of Gram Positive and Gram-negative Bacteria

BMB-DS-454.2: The students will be able to isolate the bacteria and fungus from skin

BMB-DS-454.3: The students will be able to isolate and examine the effect of Antifungal agent.

List of Experiments:

1. Isolation and identification ofE.coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of bacterial flora of skin by swab method.
3. Study of Fungal flora of skin .
4. Perform antibacterial sensitivity by Kirby-Bauer method.
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photo graphs: chickenpox, HPV warts, AIDS (candidiasis), dermatomycoses (ringworms),Polio, anthrax, herpes,
7. Study of various stages of malarial parasite in RBC using permanent mounts
8. To study the antifungal effect of Actinomycin D and Erythoromycin
9. To Study various methods for the Isolation of Nematodes
10. Visit to Animal House Facility

Text Books/ Reference Books:

1. J.Cappuccino N.&Sheeman , W.Addison.2014.Microbiology lab. Manual:Publication, California.
2. M.J.Pelczar, E.C.S.Chan and N.R.Krieg,1986. Microbiology McGraw-Hill.
3. S.Willey,Woolverton. Prescott,Harley, and S.Klein.2008. Microbiology McGraw-Hill publication
2. B.Christopher ,H.F.Colin F. Murphy and S.White.2016. Medical Virology 5th Edition.Academic Press
3. R.Patrick.PhDMurray,SKen.,A.Michael.MDPfaller. 2016.Medical Microbiology.Elsvier

Distribution of Continuous Assessment

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Course Articulation Matrix

CO Statement BMB-DS-454	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-454.1	3	2	1	-	3	1	2
BMB-DS-454.2	3	3	2	2	2	2	1
BMB-DS-454.3	2	3	3	2	3	-	2

5th Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-501: MICROBIAL PHYSIOLOGY AND METABOLISM

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes: The students will be ble to

BMB-DS-501.1 Understand the response of bacteria towards different stress conditions
BMB-DS-501.2 Elucidate the microbial diversity undergoing different metabolic pathways
BMB-DS-501.3 Differentiate between central pathways for metabolism
BMB-DS-501.4 identify the key enzymes involved in different metabolic pathways

Unit 1: Microbial Stress Responses

1.1 Osmotic Stress and Osmoregulation
1.2Oxidative Stress
1.3 pH Stress and Acid Tolerance
1.4 Thermal Stress and the Heat Shock Response /
1.5 Nutrient Stress and the Starvation Stress Response
1.6 Stringent Control
1.7 Extremophiles

Unit2: Central Pathways Of Carbohydrate Metabolism And Energy Production

2.1 Sugar degradation pathways - . EMP, ED, Pentose phosphate pathway, Phosphoketolase pathway
2.2 Gluconeogenesis
2.3Glycogen Synthesis
2.4Tricarboxylic Acid Cycle
2.5Glyoxylate Cycle
2.6Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC
2.7Anaerobic respiration

Unit 3: Fermentation Pathways

3.1 Fermentation Balances
3.2 Yeast Fermentation
3.3Lactic Acid–Producing Fermentations
3.4Butyric Acid and Solvent-Producing Fermentations
3.5 Fermentations of the Mixed-Acid Type
3.6 Propionic Acid Fermentation
3.7Acetic Acid Fermentation

Unit 4:Photosynthesis and Inorganic Metabolism

4.1 Characteristics and Metabolism of Autotrophs
4.2 Photosynthetic Bacteria and Cyanobacteria
4.3 Autotrophic CO_2 Fixation and Mechanisms of Photosynthesis

4.4 Hydrogen Bacteria , Nitrifying bacteria, sulfur bacteria, iron bacteria
4.5 Nitrifying Bacteria
4.6 Methylotrophs
4.7Methanogens
4.8Introduction to biological nitrogen fixation Ammonia assimilation. Assimilatory nitrate reduction,dissimilatory nitrate reduction, denitrification.

Text Books/ Reference Books:

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1. A.G.Moat, J.W. Foster, and M.P. Spector, 2002. Microbial physiology. John Wiley & Sons
2. M. T. Madigan;J. M. Martinko and J. Parker,2003 Brock Biology of Microorganisms:. Prentice Hall
3. IntInc Publication, 13th Edition.
4. Pelczar et al Microbiology: Concepts and Application:2009 Tata McGraw Hill Publication, 10th Ed.
5. Prescott et al., Microbiology :, 2017, 10th Edition McGraw Hill Publication
6. G.J. Tortora, B.R. Funke, and C.L. Case, 2015. *Microbiology: An Introduction, Books a la Carte Edition*. Benjamin-Cummings..
7. R.Y Stanier, J.L Ingraham, M.L Wheelis, and P.R Painter, 1992. General microbiology 5 th edition. McMillan Publications

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO (BMB-DS-501.1**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-501.1	1	1	-	1	2	-	1
BMB-DS-501.2	1	-	1	-	2	-	2
BMB-DS-501.3	2	-	1	-	2	-	2
BMB-DS-501.4	2	1	-	1	2	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-502: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The student will be able to

BMB-DS-502.1 acquire a fairly good understanding of normal microflora of human body, common diseases caused by bacteria, viruses and other microbes.

BMB-DS-502.1 acquire skills of handling microorganisms in the laboratory and study their characteristics.

BMB-DS-502.3 understand the basic components of the immune system and how this system serve to protect the host against disease-causing microbes.

BMB-DS-502.4 learn different types of vaccines and Immunotechniques for the identification of pathogen

Unit1: Introduction to Medical Microbiology

1.1 History and Scope of medical microbiology
1.2 Normal microflora of the human body: Importance of normal microflora
1.3 Normal microflora of skin, throat, gastrointestinal tract, urogenital tract
1.4 Prokaryotic Communities and Microbiomes
1.5 Prions and Toxins

Unit2: Microbial Diseases and their Control

2.1 List of diseases of various organ systems and their causative agents,. Symptoms, mode of transmission
2.2 Prophylaxis and Control of the Diseases caused by- Streptococcus pyogenes, Haemophilusinfluenzae
2.3 Mycobacterium tuberculosis, Bacillus anthracis, Clostridium tetani
2.4 Treponemapallidum, Clostridium difficile, and the viruses causing Polio, Herpes, Hepatitis, Dengue, AIDS, influenza and Japanese encephalitis.
2.5 Superficial, Subcutaneous, Systemic and opportunistic fungal infections

Unit 3: Immune system

3.1 Immune system:Structure and function of the cells, tissues and organs of immune system.
3.2 Types of immunity -, innate, acquired immunity, Humoral and cell-mediated Immunity
3.3 Complement system - function and pathways
3.4 Theory of antibody production, Immunoglobulins: Structure types, Properties, Antibody antigen reactions
3.5 Hypersensitivity reactions and their types

Unit 4: Vaccines and Immuno techniques

3.1 Active and Passive Vaccine
3.2 Whole organism and Attenuated Vaccines
3.3 DNA and Peptide Vaccines
3.4 Immunoprecipitation and complement fixation test
3.5 ELISA and its Types

Text Books/ Reference Books:

1. D.Bernard, B.Dulbecco, Eisen and Ginsberg. 1982.Microbiology including immunology and Molecular Genetics. 3rd Edition
2. I.Roitt,2006. Essential Immunology. 10th Ed. Blackwell Science.
3. Kuby.2000, Immunology. 4th edition. W. H. Free man& company publication.

Websites:

https://alraziuni.edu.ye/uploads/pdf/MICROBIOLOGY-AND-IMMUNOLOGY.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO BMB-DS-502	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3	PSO 4
BMB-DS-502.1	3	2	1	1	3	2	1	-
BMB-DS-502.2	2	3	3	2	3	1	3	1
BMB-DS-502.3	2	3	2	3	2	2	2	-
BMB-DS-502.4	1	1	3	2	1	3	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-551:MEDICAL MICROBIOLOGY AND IMMUNOLOGY LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course outcomes:

BMB-DS-551.1: The students will able to understand the various Media compositions and their uses
BMB-DS-551.2: The students will learn about the isolation and identification of Gram Positive and Gram-negative Bacteria
BMB-DS-551.3: The students will be able to isolate the bacteria and fungus from skin
BMB-DS-551.4 The students will be able to determine antimicrobial spectrum of isolated antibiotic producing microorganism.

List of Experiments:

1. To Study motility of bacteria by Hanging drop Method
2. Isolation and Identification of microorganism from hair and nails
3. To study total leukocyte count
4. To Study Different immune cells
5. To Perform Double Diffusion Test
6. To Perform SingleRadialImmuno Diffusion
7. To Perform DOT ELISA
8. To Perform Immunoelectrophoresis
9. To Perform Rocket Immunoelectrophoresis
10. To learn about Immunization Schedule and Adjuvants

Text Books/ Reference Books:

1. F. C. Hay, Olwyn M. R. Westwood,2008, Practical Immunology, 4th Edition, Wiley-Blackwell
2. D.Bernard, B.Dulbecco, Eisen and Ginsberg, 1982,Microbiology including immunology and Molecular Genetics. 3rd Edition
3. I.Roitt ,2006. Essential Immunology. 10th Ed. Blackwell Science.
4. Kuby.2000, Immunology. 4th edition. W. H. Free man& company publication.

Website:https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf

Distribution of Continuous Assessment

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Course Articulation Matrix

CO Statement BMB-DS-551	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-551.1	3	2	1	1	3	2	1
BMB-DS-551.2	2	3	3	2	3	1	3
BMB-DS-551.3	2	3	2	3	2	2	2
BMB-DS-551.4	1	1	3	2	1	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-552: MICROBIAL PHYSIOLOGY LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course outcomes:
The students will be able to:
BMB-DS-552.1 estimate the growth of bacteria by direct and indirect method
BMB-DS-552.2 cultivate different physiological groups of microorganisms
BMB-DS-552.3 Study the effect of different parameters on the growth of bacteria
BMB-DS-552.4 evaluate and discuss possible biotechnological applications of microorganisms

List of Experiments:

1. Study and plot the growth curve of *E.coli*by turbidometric and standard platecount methods.
2. Calculations of generation time and specific growth rate of bacteria fromthe graph plotted with the givendata.
3. Effect of temperature on growth of*E.coli.*
4. Effect of pH on growth of*E.coli.*
5. Effect of carbon and nitrogen sources on growth of*E.coli.*
6. Effect of salt on growth of*E.coli.*
7. Demonstration of alcoholicfermentation.
8. Demonstration of the thermal death time and decimal reduction time of*E.coli*.

Text/Reference Books:

3. K.R.Aneja,2017, Experiments in Microbiology, Plant Pathology, Tissue Culture & Biotechnology, 5th Edition New Age International Publication,.
4. J.Cappucinno&N.Sherman, 2014,Microbiology –A Lab manual,11th Edition, Addison Wesley Publication.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Experiments in lab

File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

CO Statement (BMB-DS-552)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BMB-DS-552.1	3	2	1	1	3	2	1	3
BMB-DS-552.2	2	3	3	2	3	1	3	2
BMB-DS-552.3	2	3	2	3	2	2	2	2
BMB-DS-552.4	1	1	3	2	1	3	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956**)**
DTI-500: Design, Thinking and Innovation – III

Periods/week	Credits	Max. Marks	: 50
P: 1	2.0	Continuous Assessment	: 50

Pre-requisites: Research and Innovation Catalyst-II
Course Type: Research & Training

Course outcomes
The students will be able to**:**
RIC (E)-500.1. Understand the Plagiarism / Feasibility tools
RIC (E)-500.2. Document the outcome as Research Paper / Patent / Product / Start-up /copyright

Activity 1:
1.1 Compilation / Documentation of the outcome (Research Paper / Patent / Product / Start-up /copyright).
1.2 Plagiarism / Feasibility check.
1.3 Identification of the suitable Journal / Patenting Agencies / Angel Investors.
1.4 Submission to the identified Journal / Patenting Agencies / Angel Investors.

Course Articulation Matrix:

CO Statement (DTI-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
DTI-500.1	3	3	1	1	1	1	3	3	3	3	1	3	3	1	1	2
DTI-500.2	2	3	2	3	3	3	2	3	2	2	3	3	3	3	2	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	(Marks)
1.	**Attendance**	• Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	• Judge individual student's participation in the Activities • Time bound completion of Activities	**15**
3.	**Accomplishment of the Outcome**	• Quality of the content and results • Acceptance of the outcome (Research Paper/ Patent/ Product/ Copyright) • Report submission / Presentation	**30**

References:

1. www.originlab.com
2. http://www.cambridgesoft.com/software
3. http://www.synergy.com/
4. www.mathworks.com/products/matlab.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-503: MICROBIAL QUALITY CONTROL IN FOOD & PHARMACEUTICAL INDUSTRIES

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The students will be able to-

BMB-DS-503.1 Develop a good understanding of practical aspects of microbiological safety, various detection methodologies and use of different microbiological media for application in food industry.
BMB-DS-503.2 Learn skills on disinfection of instruments and equipment in laboratory and hospitals.
BMB-DS-503.3 Gain a very good understanding of practical aspects of microbiological safety, various detection methodologies and toxicological testing of products in the pharmaceutical industry.
BMB-DS-503.4 Learn about the microbial standards for different foods and water.

Unit 1: Microbiological Laboratory and Safe Practices

1.1 Good laboratory practices
1.2 Good microbiological practices.
1.3 Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL- 1, BSL-2, BSL-3.
1.4 Discarding biohazardous waste– Methodology of Disinfection, Autoclaving & Incineration

Unit 2: Determining Microbes in Food and Pharmaceutical Samples

2.1 Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts.
2.2 Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products
2.3 Molecular methods to determine microbes in samples: Nucleic acidprobes, PCR based detection, biosensors

Unit 3: Pathogenic microorganisms of importance in food and water

3.1 Enrichment culture technique.
3.2 Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar.
3.3 Ascertaining microbial quality of milk by MBRT.
3.4 Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

Unit 4: HACCP for Food Safety and Microbial Standards:

4.1 Hazard analysis of critical control point (HACCP)- Principles,
4.2 Hazard analysis of critical control point (HACCP) - flow diagrams, limitations.
4.3 Microbial Standards for Different Foods and Water – BIS standardsfor common foods and drinking water.

Text Books/ Reference Books:

1. W.F. Harrigan,Laboratory Methods in Food Microbiology, 1998,3rd ed. Academic Press

2. N.Garg, K.L. Garg and K.G. Mukerji , Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3. J.M. Jay, M.J. Loessner, D.A.Golden, Modern Food Microbiology,2005, 7th edition. Springer
4. R.M. Baird, NA. Hodges and S.P. Denyer, Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices,2005, Taylor and Francis Inc.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-503)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-503.1	3	3	1	2	2	2	2
BMB-DS-503.2	3	3	1	1	-	2	1
BMB-DS-503.3	3	3	1	2	2	2	2
BMB-DS-503.4	2	2	-	-	-	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-504: MICROBIAL DIAGNOSTICS AND PUBLIC HEALTH

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The students will be able to-

BMB-DS-504.1:Developa very good understanding of practical aspects of collection of different clinical samplestheir transport, culture and examination by staining
BMB-DS-504.2: Develop basic skills to examine molecular and immunological diagnostic methods for diagnosis of microbial diseases.
BMB-DS-504.3:Developgood understanding of practical aspects of antibiotic sensitivity testing
BMB-DS-504.4:Apply water and food testing skills.

Unit-1: Diagnosis of Diseases

1.1Importance of Diagnosis of Diseases:Bacterial, Viral, Fungal and Protozoan
1.2 Diseases of various human body systems,
1.3Disease associated clinical samples for diagnosis.

Unit-2:Collection of Clinical Samples

2.1How to collect clinical samples (oral cavity, throat, skin, Blood,CSF, urine and feces) and precautions required.
2.2Method of transport ofclinical samples to laboratory and storage.

Unit-3: Microscopic Examination

3.1Direct Microscopic Examination and Culture.Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa- stained thin blood film for malaria.
3.2 Preparation and use of culture media-Bloodagar,Chocolateagar,Lowenstein-Jensen medium, MacConkey agar,
3.3 Distinct colony properties of various bacterial pathogens.HIV, Swine flu.

Unit-4: Microbial testing methods

4.1 Testing for Antibiotic Sensitivity in Bacteria: Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method,
4.2 Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method
4.3 Molecular approaches for diagnosis of pathogens

Reference books

1. R. Ananthanarayan and C.K.J.Paniker, 2005, Textbook of Microbiology. 7th Edition. University Press Publication.
2. P. R. Murray, E. J.Baron, J. H. Jorgensen, M. L.Landry, &M. A. Pfaller, 2006, *Manual of clinical microbiology: Volume 1* (No. Ed. 9). ASM press.
3. D.O. Fleming, J. H. Richardson, J. J. Tulis, and D. Vesley. 1995. Laboratory safety: principles and practices, 2nd ed. American Society for Microbiology, Washington, D.C.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-504**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO1**	**PSO2**	**PSO3**
BMB-DS-504.1	3	3	2	2	2	2	2
BMB-DS-504.2	3	3	3	2	2	2	1
BMB-DS-504.3	3	1	2	1	3	1	1
BMB-DS-504.4	3	3	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-505: HUMAN MICROBIAL DISEASE MANAGEMENT

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course learning outcomes: The students will

BMB-DS-505.1Develop understanding of practical aspects of diagnosis of common human infections
BMB-DS-505.2. Understand preventive measures for human infections by the use of antibiotics and vaccines.
BMB-DS-505.3. Gain knowledge of a variety of plant viruses and animal viruses.
BMB-DS-505.4. Acquire the ability to analyze principles of antivirals

UNIT-1: Human Diseases: Types and signs

1.1 Human Diseases: Infectious and non-infectious diseases, microbial and non- microbial diseases,
1.2 Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections
1.3 Sign and Symptoms of common diseases.

UNIT-2: Microbial diseases

2.1 Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases
2.2 Sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods
2.3 Study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control
2.4 Mosquito borne disease–Types and prevention

UNIT-3: Therapeutics of Microbial diseases

3.1 Treatment using antibiotics: beta lactam antibiotics (Penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides
3.2 Judicious use of antibiotics, importance of completing antibiotic regimen
3.3 Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains
3.4 Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART

UNIT-4: Prevention of Microbial Diseases

4.1General preventive measures: Importance of personalhygiene
4.2 environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect Vectors
4.3 Vaccines:Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.

Reference Books:

1. R.Ananthanarayan and C.K.J. Paniker, 2005, Textbook of Microbiology. 7th Edition. University Press Publication.
2. GF Brooks, KC Carroll, JS Butel and SA Morse.2007 Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
3. R. Goering, H. Dockrell, M. Zuckerman and D, Wakelin, 2007, Mims Medical Microbiology, 4th edition. Elsevier.
4. M Drexler, 2010, What You Need to Know About Infectious Disease, National Academies Press

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-505)	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3
BMB-DS-505.1	3	2	2	1	2	2	2
BMB-DS-505.2	3	2	2	1	2	2	2
BMB-DS-505.3	3	2	2	1	2	2	2
BMB-DS-505.4	3	2	2	1	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 506 :MUSHROOM CULTIVATION TECHNOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes: The students will be able

BMB-DS-506.1 To understand the nutritional aspects and commercial use of mushrooms for human consumption.

BMB-DS-506.2 Tolearn the practical cultivation of mushrooms

BMB-DS-506.3 Todevelop a knowledge for management of diseases affecting mushrooms

BMB-DS-506.4 Touse the mushroom cultivation technology in the various avenues for an entrepreneurship

Unit 1: Introduction

1.1 Morphology, Classification and identification of edible & non-edible/poisonousmushroom

1.2Structure & Life cycle:

1.2.1 Button mushroom (*Agaricusbisporus*)

1.2.2 Milky mushroom (*Calocybeindica*)

1.2.3 Oyster mushroom (*Pleurotussajorcaju*)

1.2.4 paddystrawmushroom (*Volvariellavolvcea*).

1.3 Breeding and genetic improvement of mushroom strains

Unit 2: Mushroom Cultivation: Principles & Requisites

2.1 Scope of mushroom cultivation.

2.2Nutritional and Medicinal value of mushroom

2.3 Principles & Requisites**:**

2.3.1 Sterilization and disinfections of substrates

2.3.2 Pasteurization of different substrates

2.3.3Isolation, growth media, Spawns production and their maintenance

Unit 3: Mushroom Cultivation: Techniques

3.1 Structure and construction of mushroom house

3.2 Layout of Traditionaland Greenhouse method

3.3 Multiplication of spawnComposting

3.4 Bed and polythene bag preparation

3.5 Spawning - casing – cropping

Unit 4: Mushroom Cultivation: Management

4.1 Insect pests

4.2 Fungal competitors and otherimportant diseases

4.3 Pestmanagement-chemical control

4.4 Harvest and Post-harvest technology: Freezing, dry freezing, drying, canning

4.5 Entrepreneurship.

Text Books/ Reference Books:

8. N. Bahl,2000, Handbook on Mushrooms,Oxford&Ibh Publishing Co. Pvt Ltd.

9. HirstBenjamin, 2015,Mushrooms: A Beginners Guide to Home Cultivation Paperback,Createspace Independent Publishing Platform
10. V. N. Pathak, 2011, Mushroom Production and Processing Technology IST Edition Hardcover, Agrobios (India)
11. Eiri Staff, 2007, Hand Book of Mushroom Cultivation, Processing and Packaging Paperback,Engineers India Research Institute

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-506**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-506.1	3	2	2	1	2	2	2
BMB-DS-506.2	3	2	2	1	2	2	2
BMB-DS-506.3	3	2	2	1	2	2	2
BMB-DS-506.4	3	2	2	1	2	2	2

6th Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-601: RECOMBINANT DNA TECHNOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The students will be able to-

BMB-DS-601.1 describe various tools and techniques in recombinant DNA technology.

BMB-DS-601.2 explain and classify the various approaches in creating a recombinant DNA molecule.

BMB-DS-601.3 select and apply the appropriate vectors, restriction enzymes and techniques used in recombinant DNA technology.

BMB-DS-601.4 compare and contrast the characteristics related to different types of tools and techniques employed in creating a recombinant molecule.

PART-A

Unit 1: Introduction to recombinant DNA technology

1.1 Tools of recombinant DNA technology:
1.2 Restriction modification enzymes used in recombinant DNA technology
1.3 Restriction endonucleases, Ligases,Phosphates, Methylases, Kinases, Adaptor, linker, DNA probes.
1.4 Plasmid cloning vector PBR322, other plasmid vectors
1.5 Cosmids, Phage vectors, Phagemids
1.6 Molecular basis of lysogeny and lytic life cycle
1.7 Shuttle vectors, Baculovirus vector system, YAC and BAC vectors

Unit 2: Gene Library

3.1 Construction cDNA library and genomic library,
3.2 Construction subtractive cDNA library
3.3 Screening of gene libraries – screening by DNA hybridization.
3.4 DNA sequencing-Maxam Gilbert, Sanger dideoxy method and automated DNA sequencing.
3.5 Overview of Next Generation Sequencing Technologies

PART-B

Unit 3: Gene expression

3.1 Gene expression in *E.coli*, Lac promoter, Tac promoter,
5.2 gene expression system in *Saccharomyces cerevisiae*,
5.3 promoters in mammalian cells,
5.4 Expression system in insects
5.5 Ti plasmid of Agrobacterium tumifaciens in gene transfer n plants
5.6 Purification of recombinant protein using tags

Unit 4: Techniques used in RDT

4.1 Physical methods and biological methods of gene delivery,
4.2 Site Directed mutagenesis
4.3 Transposon tagging

4.4Genome editing Technologies
4.5 Southern, Northern and Western,
4.6Principles and PCR- inverse PCR, nested PCR, RT-PCR, overlap extension PCR,Isothermal PCR
4.8 rDNA-Production of therapeutic proteins-insulin and human growth hormones
4.9 Human gene therapy-types, methodology, limitation and application, gene silencing,

Text Books/Reference Books:

1. S.B.Primrose and R.M.Twyman, 2008, Principles of gene manipulation and Genomics, Blackwell Scientific Publications.
2. J.D.Watson et al,1992, Recombinant DNA, W.H. Freeman and Company Publication.
3. T.A. Brown,2006, Gene Cloning: Blackwell Publication.
4. B. R Glick and J. J. Pasternak, 2010, Molecular Biotechnology: Principles Application of Recombinant DNA, ASM Press Publication, Washington DC.
5. D. S.T. Nicholl,2012, An Introduction to Genetic Engineering: Cambridge University Press Publication.
6. Kingsman and Kingsman, 1988, Genetic Engineering: An introduction to Gene analysis and exploitation in eukaryotes, Oxford, England, Blackwell Scientific Publication.
7. Glover and Hames, 1995, DNA cloning: A Practical Approach, Oxford Press Publication.
8. J. D. Watson,2007,Recombinant DNA : Genes and Genomes - a short course, Cold Spring Habor Laboratory Press.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO (BMB-DS-601)	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-601.1	3	3	2	2	3	3	2
BMB-DS-601.2	3	3	3	3	2	2	1
BMB-DS-601.3	3	1	2	2	2	1	1
BMB-DS-601.4	3	3	2	2	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 602: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The students will be able to-

BMB-DS 602.1: understand practices for working in a microbiology laboratory taking all safety measures, handling of live bacteria.

BMB-DS 602.2: learn about methods of disposal of infectious waste, care of the equipment requiring safetyaudit.

BMB-DS 602.3: gain knowledge of basic concepts related to Intellectual Property Rights.

BMB-DS 602.4: gain knowledge about the process of patent filing, and some well-known/well publicized case studies relatedto IPR.

PART-A

Unit 1: Introduction to Biosafety

1.1. Biohazards,biosafety issues and social responsibility
1.2. Primary containment for biohazards
1.3. Biological safety cabinets and their types
1.4. Biosafety levels of specific microorganisms
1.5. AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions

Unit 2: Biosafety Guidelines

2.1 Biosafety guidelines and regulations, national and international
2.2 GMOs/LMOs- Concerns and challenges
2.3 Institutional Biosafety Committees (IBSC), RCGM, GEAC etc.
2.4 Role of biosafety committees for applications of GMOs in food and agriculture; Pharmaceuticals; Environmental release of GMOs.
2.5 Overview of international agreements- Cartagena Protocol.

PART-B

Unit 3: Introduction to Intellectual Property Rights

3.1 Patents
3.2 Trademarks
3.3 Copyrights & related rights
3.4 Industrial design and rights
3.5 Traditional Knowledge
3.6 Geographical indications
3.7 Importance of IPR

Unit 4: Grant of Patent and Patenting Authorities

4.1 Patentable and non-patentable
4.2 Types of patent applications- Ordinary, PCT
4.3 Grant of patents and patenting authorities

4.4 An introduction to patent filing procedures; rights & duties of patent owner; Patent licensing & agreement.
4.5 Agreements and Treaties –GATT, TRIPS, WIPO etc.

Text Books/Reference Books

1. J.A.Thomas and R.L. Fuch, 2002, Biotechnology and Safety Evaluation, 3rd Edition, Academic Press Publication.
2. D.A. Flemingand D.L. Hunt, 2000, Biological safety Principles and practices,3rd Edition, ASM Press Publication, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12), Legal economic and ethicaldimensions VCH.
4. R.W. O'Donnell,J.J.O'Malley, R.J.Huis, G.B.J Halt, Intellectual Property in the Food Technology Industry, Springer

Software required/Weblinks:

http://www.unesco.org/new/en/social-and-human-sciences/themes/bioethics/

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BMB-DS-602)	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3
BMB-DS-602.1	1	3	3	3	1	3	1
BMB-DS-602.2	1	1	-	1	1	3	1
BMB-DS-602.3	-	-	3	2	-	-	2
BMB-DS-602.4	-	-	3	2	-	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BB-DS-651: RECOMBINANT DNA TECHNOLOGY LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Course Outcomes:

The students will be able to-

BMB-DS-651.1 learn the isolation of genomic DNA and plasmid DNA from the host.

BMB-DS-651.2 reproduce the basic steps involved in cloning a gene of interest in a particular host its screening.

BMB-DS-651.3 compare and contrast the wild type and recombinant clones

BMB-DS-651.4 perform and analyze the various techniques used in recombinant DNA technology

List of Experiments:

1. Isolation of genomic DNA from the target organism
2. Plasmid isolation from the host.
3. Preparation of the vector for cloning
4. To observe the ligation of target gene in vector
5. To study the Competent cell preparation
6. To study transformation of ligated construct.
7. Induction of the target gene expression in the clone using IPTG
8. To screen the cloned colonies using Blue/White screening method
9. To study and perform the technique of Northern blotting.
10. To study and perform the technique of Southern blotting.

Instructions for Exam: Every student needs to complete 08 experiments in a semester. One experiment out of 08 given randomly needs to be performed in exams.

Reference Books:

1. J. Sambrook and D.W. Russell,2005,Molecular Cloning- A Laboratory Manual, Cold Spring Harbor Laboratory Press Publication, New York.

Distribution of Continuous Evaluation

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Evaluation Tools:

Experiments in lab

File work/Class Performance

Viva (Question and answers in lab)

End Term Practical Examination

Course Articulation Matrix

CO (BMB-DS-651)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-651.1	3	3	2	2	3	3	2
BMB-DS-651.2	3	3	3	3	2	2	1
BMB-DS-651.3	3	1	2	2	2	1	1
BMB-DS-651.4	3	1	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-652: BIOSAFETY AND IPR LAB

Periods/week	Credits	Max. Marks	:100
L: 3	1.5	Continuous Evaluation	:50
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:50

Pre-requisites: Molecular Biology Lab (BBT-DS-451)
Course Type: Core

Course Outcomes:
The students will be able to-
BMB-DS-652.1 Get a clear idea about the criteria to consider while designing, constructing, commissioning & operating the Biosafety Level-3 (BSL-3) laboratory(visit to Research lab)
BMB-DS-652.2 Develope knowledge of patent filing,
BMB-DS-652.3 Assimilate the indepth experience through some well-known/well-publicized case studies related to IPR

List of Experiments:

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

Reference books
1. Susan K Private Power, Public Law: The Globalization of Intellectual Property RightsBy,2000,SellCambridge University Press
2. Alexander I.Poltorak; Paul J. Lerner Wiley, 2011 Essentials of Intellectual Property: Law, Economics, and StrategyBy (2nd edition
3. M K Sateesh .Bioethics and Biosafety . Kindle Edition
4. D. O. Fleming, D. L. Hunt, 2006 Biological Safety: Principles and Practices, 4th Edition. ASM.

Course Articulation Matrix

CO (BMB-DS-652)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-652.1	3	3	2	2	3	3	2
BMB-DS-652.2	3	3	3	3	2	2	1
BMB-DS-652.3	3	1	2	2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-MB-600: PROJECT WORK

Periods/week Credits	Max. Mark : 300
P: 12 6	Continuous Assessment : 200
Duration of Examination: 3 Hrs	End Semester Examination : 100

Course outcomes:

The students will be able to-

PROJ-MB-600.1 survey relevant research literature.

PROJ-MB-600.2 assimilate the purpose of research through literature survey and learn to communicate effectively.

PROJ-MB-600.3 acquire ability to identify the gaps in research and appraise the importance of ethics in research.

PROJ-MB-600.4 hypothesize the solutions to real life problems.

Every student will have to undertake a research project in the field relevant to Microbiology. Each student will be allocated a faculty supervisor depending upon the area of his/ her interest. In further course of time the student will identify the research problem and do the literature survey. Every student is expected to at least build the hypothesis, set the objectives and decide upon the work-plan for the research to be carried out. Student will work towards the accomplishment of the objectives set after due literature survey. During this course of time he/she will be regularly monitored and evaluated by the Departmental Project Committee/ Project Supervisor. Continuous monitoring will include Mid Term Review Presentations and Feedback from supervisor. At the end of the Major Project, each student will have to submit the report (hard bound), deliver a presentation pertaining to research work undertaken and will have to appear for viva during Internal and End Semester Examination.

The overall evaluation scheme for the Dissertation will be as follows-

Continuous Evaluation:

Continuous Performance Review-I	- 50 Marks
Continuous Performance Review-II	- 50 Marks
Presentation	- 40 Marks
Project Report	- 40 Marks
Attendance	- 10 Marks
TOTAL	**: 200 marks**

External Evaluation-

1.	Dissertation Report	: 50 marks
2.	Presentation	: 25marks
3.	Viva	: 25 marks
	TOTAL	**: 100 marks**

Course Articulation Matrix

Project Work (PROJ-MB-600)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
PROJ-MB-600.1	3	3	2	3	3	3	3
PROJ-MB-600.2	2	3	2	3	3	3	3
PROJ-MB-600.3	1	3	2	3	3	3	3
PROJ-MB-600.4	1	1	1	1	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-603 :FOOD FERMENTATION TECHNOLOGY

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes: The students will be able to

BMB-DS-603.1 Appreciate the relationship between food, nutrition and health
BMB-DS-603.2 understand practical aspects of commercially produced food and fermentative products.
BMB-DS-603.3 understand practical use of microbiology for better production of home based food and fermentation products for day to day use
BMB-DS-603.4 analyze the biochemical changes during the fermentation process

UNIT 1: Fermented Foods
1.1 Definition, types, advantages and health benefits,
1.2fermented foods used by Common public,
1.3Starter culture: Uses in the Food Industry
1.4 Effect of Fermentation on Vitamin Content in Food Fermentation monitoring and control of microbial cultures for food ingredient manufacture
1.5Emerging Trends and Opportunities in Food Fermentation
1.6 Probiotic Foods:Definition, types, microorganisms and health Benefits

UNIT 2: Milk Based Fermented Foods
2.1 Fermentation : role of Lactic Acid Bacteria
2.2 Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms production process.

UNIT 3: Grain Based Fermented Foods: Soy sauce, Bread, Idli and Dosa:
3.1Microorganisms and production process, Preparation and preservation
3.2 Biochemical changes during cereal fermentation
3.3 Traditional wheat-based fermented foods
3. 4Traditional corn-based fermented foods .

UNIT 4 Vegetable and non-vegetabe Based Fermented Foods:

4.1Pickels, Saeurkraut
4.2Microorganisms and production process.
4.3 Preparation and preservation methods.
4.4 Plant-Based Fermented Drinks
4.5 Potential Mechanisms Involved in Health Benefits
4.6 Safety of Fermented Fruits and Vegetables
4.7Fermented Meat and Fish:Types, microorganisms involved,fermentation process

Reference books

1. P.F. Stanbury, A.Whitaker, and S.J. Hall, 2013, Principles of fermentation technology. Elsevier.
2. J.M.Jay,2005, Modern Food Microbiology, VNR Publication, New York.
3. M.R.Adams,2008, Food Microbiology, Royal Society of Chemistry, Publication.
4. N.M.Potter, 2007,Food Science. The AVI Publishing Co, Westport Connecticut, USA.
5. B. McNeil, D. Archer,I.Giavasis, and L. Harvey, 2013, Microbial production of food ingredients, enzymes and nutraceuticals. Elsevier.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

Project Work (BMB-DS-603**)**	**PO1**	**PO2**	**PO3**	**PO4**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-603.1	3	3	2	3	3	3	3
BMB-DS-603.2	2	3	2	3	3	3	3
BMB-DS-603.3	1	3	2	3	3	3	3
BMB-DS-603.4	1	1	1	1	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS 604 :MICROBIAL PRODUCTS (e. g. Antibiotics, Bio-fertilizers, Biofuels, Bio-pesticides,Vaccines etc.)

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes: The students will be able to

BMB-DS-604.1 understand the types and production of Antibiotics
BMB-DS-604.2 learn the types and production of Biofuels
BMB-DS-604.3 develop skill for production of Biofertilizers&Biopesticides
BMB-DS-604.4 Tounderstand the types and production of Vaccines

PART-A

Unit 1: Antibiotics

1.1 Definition &Types of Antibiotics
1.2 Classification of antibiotics on the basis of structure and mode of action
1.3 Production of antibiotics
    1.3.1 Penicillin
    1.3.2 Semi-synthetic penicillins
1.4 Primary screening of antibiotic producers
1.5 Microbiological assay of antibiotics

Unit 2: Biofuels

2.1.Biofuels (ethanol and methane) from organic residues
2.2 Biofuels from algae
2.3 Cellulose Ethanol
2.4 Switch grass, Miscanthus, Poplar, wood, Logging residue, tall fescue, Municipal solid waste
2.5 Biodiesel: Biodiesel chemistry, Commercial Biodiesel Production, Biodiesel EmissionsCase Study: Piedmont Biofuels, Alternative liquid fuels.

PART-B

Unit 3: Biofertilizers&Biopesticides

3.1 Nitrogen Fixing Bacteria
3.2 Plant growth promoting Microorganisms
3.3 Blue Green Algae (BGA)
3.4 Trichoderma spp.
3.5 Integrated Pest Management
3.6 Mass Production of Biofertilizers&Biopesticides

Unit 4: Vaccine

4.1 Vaccines and its types
4.2 Vaccines: active, passive
4.3 Viral Vaccines- Conventional vaccines killed and attenuated
4.4 Modern vaccines-recombinant proteins, subunits, DNA vaccines, peptides, immune-modulators (cytokines)
4.5 vaccine delivery and adjuvants, large scale manufacturing—QA/QC issues

Text Books/ Reference Books:

1. L. Sunggyu, and Y. T Shah, 2012,Biofuels and Bioenergy: Processes and Technologies, CRC Press
2. N.S.S.Rao,1996,Biofertilizer in agriculture and Forestry: Oxford &IBM Pvt Ltd. Publication.
3. G.S. Dhaliwal and R. Arora, 1998, Principles of Insect Pest Management, Kalyani Publication, New Delhi
4. H. Wolfram Gerlich (Editor), H. Detlev Krueger (Editor), Ulrich Rainer (Editor), 1996, Chimeric Virus like Particles as Vaccines: Latest edition / Pub. Date: November 1996, Karger, S. Inc. Publication.
5. A. O. Walter, 2003, Vaccines: Stanley A. Plotkin, Elsevier Health Sciences Publication.

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-604)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3	PSO 4
BMB-DS-604.1	3	3	3	2	1	2	3	1
BMB-DS-604.2	3	3	1	1	3	1	3	2
BMB-DS-604.3	3	3	1	2	1	3	2	1
BMB-DS-604.4	3	3	1	1	2	1	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

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BMB-DS-605: MICROBIOLOGICAL ANALYSIS OF AIR, WATER & SOIL

Periods/week	Credits	Max. Marks	:200
L: 4 T: 0	4	Continuous Evaluation	:100
Duration of Ext. Exam: 3 Hrs		End Semester Examination	:100

Course Outcomes:

The student will be able to

BMB-DS-605.1 developed a very good understanding and skills of the analysis of air.

BMB-DS-605.2analyze water quality for various purposes

BMB-DS-605.3examine and identified the type of soil and their properties

BMB-DS-605.4Do control measures based on knowledge of various technology of detection and can take measures

PART-A

Unit1: Microbial Analysis of Air

1.1 Bioaerosols, 2 Bioaerosol sampling, air samplers, methods of analysis,

1.2 Air borne microorganisms (bacteria, Viruses, fungi)

1.3 Impact on human health and environment by air borne microbes

1.4 Significance of air borne microbes in food and pharma industries and operation theatres

1.5 Allergens.

Unit2: Microbial Analysis of Air

2.1Water borne pathogens,

2.2 water borne diseases. Sample Collection,

2.3 Treatment and safety of drinking(potable)water

2.4 methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms

2.5 Membrane filter technique and (c) Presence/absence tests

PART-B

Unit3: Microbial Analysis of Soil

3.1Soil borne pathogens

3.2 soil borne diseases

3.3 Sampling of soil, sample collection and analysis.

3.4 Isolation and identification of pathogens.

3.5 Soil testing methods. Soil treatment.

Unit4 :Control Measures

1.1 Fate of bioaerosols,

1.2 Inactivation mechanisms – UV light,

1.3 HEPA filters, desiccation,

1.4 Incineration. Precipitation, chemical disinfection

1.5 Filtration, high temperature, UV light

Text Books/ Reference Books:

1. M.T. Medigan, J. M Martinko,.andJ.Parker, 2006.Brock Biology of Microorganisms. Pearson Education Inc. , New York.

2. M.J. Alexander,2006. Microbial ecology. Wiley & Sons, Inc., New York.
3. M.J.Alexander,1978, Introduction to soil microbiology.Wiley& Sons Inc., New York
4. K.H.Barker, andD.S.Herson .2016.Bioremediation. Mc Craw Hill Inc., New York.
5. F.H. Chapelle, 2000. Ground Water Microbiology and Geochemistry. New York: John Wiley & Sons

Websites:

https://www.lobov.com.ar/downloads/Environmental%20testing%20for%20water,%20air,%20and%20soil5.pdf

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Parameter	Weightage
Two Sessional (Mid-Term)Tests	60%
Assignments	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Assignment/Tutorials
Class Performance
Sessional Examinations
End Semester Examination

Course Articulation Matrix

CO Statement (BMB-DS-605)	PO1	PO2	PO3	PO4	PSO 1	PSO 2	PSO 3
BMB-DS-605.1	3	2	-	1	3	3	2
BMB-DS-605.2	2	3	2	2	2	2	1
BMB-DS-605.3	1	2	1	2	2	3	1
BMB-DS-605.4	3	1	2	1	3	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES, FARIDABAD

(Deemed to be University under section 3 of the UGC Act 1956)

BMB-DS-303: Interaction with Entrepreneurs in Microbial Technology and startups

Periods/week Credits
L: 4 T: 0 4

Max. Marks : 200

Continuous Assessment: 100

Duration of Ext. Exam: 3 Hrs

End Semester Examination: 100

Course Outcomes:

The students will be able to-

BMB-DS-303.1. Have developed a very good understanding of area where Microbial Technology has the potential for possible commercialization

BMB-DS-303.2. Have developed a preliminary understanding of how a certain microbial technology may be further developed for initiating startup and developing it into a commercial enterprise

After Interactions with experts from microbial biotechnology related industries/ enterprises/ startups, the students would submit a short report and bring out innovations, novel ideas or the further improvements related to products being produced by such organizations.

Text Books/Reference Books:

Instruction for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (covering all the units). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Continuous Evaluation:

Mid Review-I : 50 marks
Mid Review-II :50 marks

External Evaluation-

1. Report : 50 marks
2. Presentation : 25marks
3. Viva : 25 marks

Course Articulation Matrix

CO Statement (BMB-DS-303)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**
BMB-DS-303.1	2	2	2	2	2	2	1	3	-	1