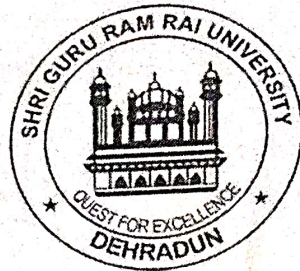


# SHRI GURU RAM RAI UNIVERSITY

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



M  
PA Diplo  
NEP

## SYLLABUS FOR MASTER OF SCIENCE (MICROBIOLOGY) 1 YEAR COURSE

OR

## POST GRADUATE DIPLOMA IN MICROBIOLOGY

School of Basic & Applied Sciences

National Education Policy-2020 NEP-

School of Basic and Applied Sciences

(Effective from Academic Session 2025-2026 Onward)

DEPARTMENT OF MICROBIOLOGY

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Vidushi

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Dr. [Name]

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Dr. [Name]



## VISION AND MISSION- DEPARTMENT OF MICROBIOLOGY

**Vision** Our vision is to cultivate a new generation of microbiologists who are innovative leaders in scientific research and societal advancement. We strive to empower students with the knowledge and skills to address global challenges such as infectious diseases, food security, and environmental sustainability. By promoting interdisciplinary collaboration and responsible research, we aim to contribute to a healthier and more sustainable world.

**Mission** The mission of the Microbiology course is to provide students with a comprehensive understanding of microbial life and its impact on the environment, human health, and industry. We aim to foster critical thinking, analytical skills, and a commitment to ethical research practices. Through hands-on laboratory experiences, students will develop practical skills essential for careers in research, healthcare, and biotechnology.

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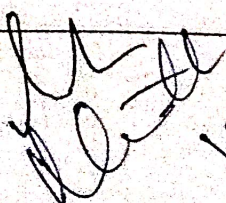
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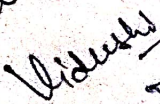


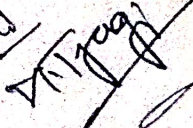
**CURRICULUM MASTER OF SCIENCE- MICROBIOLOGY POSTGRADUATE ONE YEAR DEGREE PROGRAMME (2025-26 Onward)**

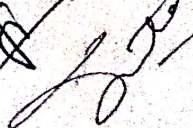
1. **Nomenclature:** There will be full time Master's Degree Programme named as M.Sc. in Microbiology which will be written as M.Sc. Microbiology. The duration of this programme shall be of one year (one full academic year ) which shall be divided in to two semesters. Each semester will be of six months. Actual teaching in each semester is required minimum of 90 days. The examination for first semester will normally be held in the month of December and for the second semester in the month of May or as convenient to the University.
2. **The Medium of Instruction:** The medium of Instruction will be English.
3. **The Medium of Examination:** The medium of examination will be English.
4. **Eligibility to apply for Admission:** No candidate shall be eligible for admission to One Year Full Time M.Sc. Microbiology unless he/she has successfully completed a four years Under Graduate Degree either Honors or Honors with Research (with any Biological/Applied science subjects/Agriculture sciences/Medical sciences/Biotechnology/Microbiology/Zoology/Botany) with prescribed number of Credits through the Examinations conducted by a University/Autonomous Institution or possesses such qualifications as recognized by the University. Further a candidate holding four years Bachelor Degree (either Honors or Honors with Research) in any biological science discipline from a recognized University without credit system shall also be eligible. The maximum age of a candidate for taking admission in the programme and the gap between the last Degree/Diploma courses shall be as per the norms as prescribed by the university from time to time
5. **Selection Procedure for Admission:** A candidate willing to seek admission to M.Sc. Microbiology will have to appear in Written Entrance Test conducted by the University or on behalf of the University and followed by the counselling as per University norms. The selection for admission will be made on merit basis or as per University norms.
6. **Semesters:** (a) An academic year shall consist of two semesters: Odd Semester (I Semester) : generally July to November/December Even Semester (II Semester): generally December to January to May/ June The academic calendar for each semester shall be notified well before the commencement of the semester by the Dean, School of Basic and Applied Sciences. (b) A semester shall normally extend over a period of 15 weeks. Each week shall have 30 hours of instruction including lab/ field work as applicable.
7. **Credits:** (a) Credit defines the quantum of contents/ syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus credits shall be assigned on the basis of the number of lectures/ tutorials / laboratory work/ project work and other forms of learning required to complete the

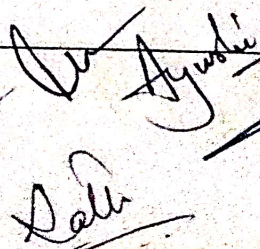
DEPARTMENT OF MICROBIOLOGY

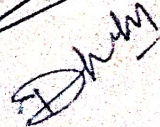














course contents in a 15 week schedule. (b) 1 Credit = 1 hour of lecture for theory and 1 Credit = 3 hour of laboratory for practical and dissertation. (c) Motivate students with industrial visit, educational trip, seminar/conference during semesters (not mandatory).

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

9. The Credit Based Course Structure: Master of Science (Microbiology)- One Year Programme- As per NEP 2020 and Choice Based Credit System (CBCS) One year Master's Program in Microbiology shall be based on the choice based credit system or as per NEP 2020 in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week. The student shall be eligible for admission to one year Master's Degree Program in Microbiology after he/she has successfully completed a four years undergraduate degree (either Honors or Honors with Research) or earned prescribed number of credits through the examinations conducted by University as equivalent to an undergraduate four year degree program (either Honors or Honors with Research). Core courses prescribed for every Semester shall be mandatory for all students registered for the one year Master's Program in Microbiology and shall carry minimum 40 credits (for one year program). There shall be Elective courses offered in semester I and shall carry a minimum of 10 credits and 10 credits shall be covered by two core paper both are consider as course paper with 20 credits.. The dissertation would be allotted in the beginning of III Semester and candidate would submit the thesis/report during IV Semester examination. The dissertation may be in the form of a field based research work/ project work/ practical training. The students may complete the dissertation work in the department/ other research institutes/ industries/ hospitals etc. The 1- Year Masters Programme will have the following components:

Core course (C): Minimum 10 credits 2) Elective course (E): Minimum 10 credits (Core+ Elective= Course papers ) 3) Major Research/ Dissertation 20 4)

### **Eligibility for admission:**

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized equivalent to the Plus Two of the Higher Secondary Board in with not less than- 45%-marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules. \*If a student earns 80 credits from the courses offered by the department, then M. Sc. Microbiology will be awarded to the student.

**Exit Point:** For those who join 2year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

Candidates who have completed 4-year UG programme or a 3 year UG and 2 year PG programme subjects will be eligible for admission in M.S.c Microbiology course.

1. Master's Degree. Programme duration: One year (two semesters) after obtaining a Bachelor's degree (Honours/Research).
2. Master's Degree. Programme duration: two years (four semesters) after obtaining a 3 yr Bachelor's degree;

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3. Post-Graduate Diploma. Programme duration: One year (2 semesters) after any bachelor's degree
- Post Graduate Diploma after completion of 1st year of 2-year PG program; and Minimum of 40 credits for individuals who have completed a bachelor's programme
- PGD after 3-year Bachelor degree.
  - PGD after 4-year bachelor degree

**Multiple Entry Multiple Exit (ME-ME) in Microbiology course work.**

S.NO.	ACADEMIC LEVEL	ENTRY QUALIFICATION *	EXIT QUALIFICATION AND CREDITS required for the level
1.	MASTERS in Microbiology ( 2 year of Master Program)	Bachelor degree (after 3 years of UG)	Master's degree; and Minimum of 80 credits from the first and second years of the program, with minimum of 40 credits in the first year and minimum of 40 credits in the second year of the program.
2.	MASTER'S in Microbiology ( One year program after 4 year UG)	Bachelor's degree ( honors/ honors with research) or Post Graduate Diploma	Master's degree; and Minimum of 40 credits for individuals who have completed a bachelor's degree (Honors/ Honors with Research)
3.	Master's programme in Microbiology	Bachelor's degree (honors/ honors with research)	Master's degree; and Minimum of 80 credits from the first and second years of the programme, with minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme in Microbiology.

**M. Sc. Microbiology**

**Course Components of Academic Program**

\*If a student earns 80 credits from the courses offered by the department, then M. Sc. Microbiology will be awarded to the student.

COURSE COMPONENTS	NO.	CREDITS
Discipline Specific Core Courses (DSC)	7	23
Seminar (SM), Ability Enhancement Course (AEC), Project (PROJ)	02	20
<b>GRAND TOTAL</b>		<b>43</b>

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**Exit Point:** For those who join 2 year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

Candidates who have completed 4-year UG programme or a 3 year UG and 2 year PG programme subjects will be eligible for admission in M.S.c Microbiology course.

4. Master's Degree. Programme duration: One year (two semesters) after obtaining a Bachelor's degree (Honours/Research).
5. Master's Degree. Programme duration: two years (four semesters) after obtaining a 3 yr Bachelor's degree;
6. Post-Graduate Diploma. Programme duration: One year (2 semesters) after any bachelor's degree
  - Post Graduate Diploma after completion of 1st year of 2-year PG program; and Minimum of 40 credits for individuals who have completed a bachelor's programme (Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma in Microbiology).
  - PGD after 3-year Bachelor degree.
  - PGD after 4-year bachelor degree.

**DISCIPLINE SPECIFIC CORE COURSES (DSC)**

S. No.	Course Code	Course Title	Credits (L + P)
1.	MBDS-101	Medical Microbiology	3
2.	MBDS-102	Industrial Microbiology AND PHARMACEUTICAL	3

**DEPARTMENT SPECIFIC ELECTIVE OFFERED (DSE)**

3.	MBDE-103	Agricultural microbiology	3
4.	MBDE-104	Food and dairy microbiology	3
5.	MBDL-105	Lab Course based on MBDS-101 and MBDS-102	4
6.	MBDL-106	Lab Course based on MBDE-103 and MBDE-104	4
7.	MBDS-201	Epidemiology	3
8.	MBDL-206	Lab course based on MBDS-201	4

**Seminar (SM), Ability Enhancement Course (AEC), Project (PROJ)**

9.	MBDS-204	Dissertation	10
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DEPARTMENT OF MICROBIOLOGY

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10.	MBPROJ - 205/AEC-205	Seminar Report Writing and Presentation /Publication (Review article/book chapter, Research Paper etc)	10
<b>TOTAL</b>			<b>47</b>

11. **Student Advisor:** Every student shall have a teacher of the Department as his/her Student Advisor. All teachers of the department shall function as Student Advisors and will have more or less equal number of students with them. The Student Advisor will advise the students in choosing Elective courses and offer all possible student support services.
12. **Attendance:** a. The teacher handling a course shall be responsible for maintaining a record of attendance of students who have registered for the course. b. All teachers shall intimate the Head of the Department at least seven calendar days before the last instruction day in the semester, the particulars of all students who have less than 75% attendance in one or more courses. c. A candidate who has less than 75% attendance shall not be permitted to sit for the End-semester examination in the course in which the shortfall exists. However, it shall be open to the Dean/HOD to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 60%. d. A candidate who fails to put in least 75% attendance in I semester shall not be allowed to pursue the studies in II semester. Such candidates may apply to the Dean/HOD for re-registration in the I semester in the next academic session. Note : Rest of the provisions will be as framed by the University.
13. **Examination and Evaluation** (a) Evaluation will be done on a continuous basis. Three times during each semester. For The purpose of uniformity, there will be a uniform procedure of examination to be adopted by all teachers. There will be two Sessional tests (Three if any student are unable to attend any sessional test) and one End-semester examination. (b) Sessional tests (of one to two hours duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment. It will be obligatory for the Students to attend the both Sessional tests, failing which they will not be allowed to appear in the concerned semester examination. The Sessional test as part of the continuous internal assessment shall be conducted and evaluated by the teacher offering the course.
14. **A Student cannot repeat Sessional Tests (without permission from HOD).** However, if for any compulsive reason the student could not attend the test, the prerogative of arranging a special test lies with the teacher with the approval of the Head of the Department. In case of students who could not attend any of the Sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the concerned semester examinations by the concerned faculty member after the approval of the Head of the Department and the Dean concerned. (c) The Sessional tests will carry 40% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades. (d) There shall be a written End Semester Examination which shall be of 2/3 hours duration carrying 60% of total Marks assigned for the course, covering the entire syllabus prescribed for the course. (e) The End Semester practical examinations (field tour report, project report and Training report) shall normally be held before the theory examination/or as per convenience by the Department . The internal faculty shall associate themselves with the examination process. (f) Valuation of Dissertation and Viva- voce: Dissertation / project report shall be evaluated jointly by internal and one external examiner

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# M.S.c Microbiology-I Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
<b>Theory</b>										
1	Core	MB DS-101	Medical Microbiology	3	0	0	3	40	60	100
2	Core	MB DS-102	Industrial Microbiology AND PHARMACEUTICAL	3	0	0	3	40	60	100
3	Elective-I	MB DE-103	Elective - I a) food and dairy microbiology	3	0	0	3	40	60	100
4	Elective-II	MB DE-104	Elective - II d) Agricultural microbiology	3	0	0	3	40	60	100
5.	Lab	MB DL-103	Lab Course-I (Based on paper 1 & 2)	0	0	4	4	40	60	100
6	Lab	MB DL-103	Lab Course-I (Based on paper 3 & 4)	0	0	4	4	40	60	100
				12	0	8	20	240	360	600

## M.S.c Microbiology-II Semester

8.	Core	MB DS-201	Epidemiology	3	0	0	3	40	60	100
9.	Lab	MB DL-202	Lab based on MBDS-201	4	0	0	4	40	60	100
10.	Pre-Project Presentation /Ability Enhancement Course	AEC -203	Synopsis Writing Skill	1	0	0	1	40	60	100

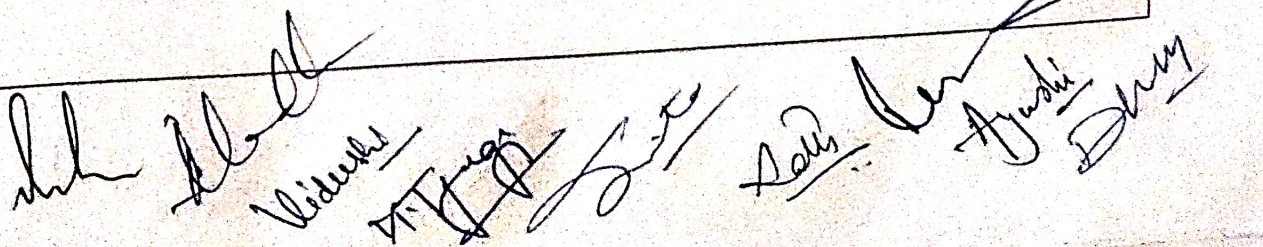
DEPARTMENT OF MICROBIOLOGY

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 Vikas, Anurag, Sathya, Anand, Princy



9.	Project	MB DS- 204	Dissertation	10	0	0	10	50	100	150
10.	Seminar Report Writing and Presentation	MBP ROJ - 205/A EC- 205	Seminar Report Writing and Presentation /Publication (Review article/book chapter, Research Paper etc)	10	0	0	10	50	100	150
TOTAL				28	0	0	28	460	380	600

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Course code	: MBDS—101			
Course Name	: Medical Microbiology			
Semester /Year	: I			
	L	T	P	C
	3	0	0	3

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

**Course Objectives:** The objectives of this course are

1. To make student aware to Normal microbiota of human body.
2. To gain knowledge about mechanism of pathogenesis.
3. To gain knowledge of bacterial, viral and fungal disease.

**Course Content**

**TOTAL HOURS: 60**

**CREDITS: 03**

**Unit I: Basics of Medical Microbiology**

Normal microbiota of human body; Role of resident flora and human host; Routes of transmission of pathogens; Nosocomial infections; Collection, transportation and processing of clinical samples; Isolation and identification of pathogenic organisms; Quality control in medical microbiology laboratory.

**Unit II: Pathogenesis**

Pathogenicity islands; Mechanism of pathogenesis: Mechanism of bacterial adhesion, colonization and invasion, Protein toxins (Classification and mode of action), Cytoskeletal modulation of host cell; Mechanism of action of antimicrobial agents;

**Unit III: Antimicrobial Chemotherapy**

Methods of drug susceptibility testing: Kirby-Bauer's disc diffusion method, Stokes method, Agar dilution method, Broth dilution method, E-strip method; Emergence of drug resistance in bacteria (MRSA, ESBL and MDR TB); Resistance mechanism; Various types of vaccines for prevention of infectious diseases; COVID Vaccine, National immunization program and immunization schedule.

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**Unit IV: Bacterial Diseases**

Clinical features, transmission, characteristics of causative organism, pathogenesis, laboratory diagnosis, prevention and control of bacterial diseases and clinical syndromes: Cholera, Leprosy, Diphtheria, Tetanus, Meningitis, Conjunctivitis, Pneumonia and Gastroenteritis.

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## Unit V: Viral and Fungal Diseases

Clinical features, transmission, characteristics of causative organism, pathogenesis, laboratory diagnosis, prevention and control of viral diseases: Herpes, Chikungunya, Influenza, Measles, Mumps, Hepatitis, HIV, Coronavirus, Viral cancer. Clinical features, transmission, pathogenesis, laboratory diagnosis, prevention and control of fungal diseases: Aspergillosis, Cryptococcosis, Candidiasis, Blastomycosis.

### Text Books:

1. Arti Kapil. (2013). *Ananthnarayan & Paniker's Textbook of Microbiology*, (9th ed). Universities Press (India) Private Limited, ISBN: 9788173718892.
2. Ananthnarayanan, R. and Panicker, C.K.J. *Textbook of Microbiology*. Orient Longman, Hyderabad.
3. Chakraborty, P. *A Textbook of Microbiology*. New Central Book Agency Private Limited, Calcutta.
4. Paniker, J. *Textbook of Medical Parasitology*. Jaypee Brothers Medical Private Limited, New Delhi.

### Reference Books

1. Koneman, E.W. *Koneman's Color Atlas and Textbook of Diagnostic Microbiology*. Lippincott Williams and Wilkins, Philadelphia.
2. Topley, W.W.C., Wilson, S.G. and Parker, M.T. *Topley and Wilson's Principles of Bacteriology, Virology and Immunity*. Edward Arnold, London.
3. Greenwood, D., Slack, R.B. and Peutherer, J.F. *Medical Microbiology*. Churchill Livingstone, London.
4. Mahon, C.R. and Manuselis, G. *Textbook of Diagnostic Microbiology*. Saunders, Philadelphia.

### Course Outcomes (Cos):

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

CO1	Define Normal microbiota of human body, pathogenesis, Antimicrobial Chemotherapy, Bacterial Diseases, Viral and Fungal Diseases.
CO2	Summarize the role of resident flora and human host, Pathogenicity islands, drug susceptibility testing, bacterial diseases and clinical syndromes, control of viral diseases.
CO3	Explain the normal microflora in human, mechanism of pathogenesis, methods of drug susceptibility testing, transmission, characteristics of causative organism, pathogenesis, laboratory diagnosis, prevention and control of bacterial, viral and fungal disease.
CO4	Explain infection and pathogenicity, role of microorganism in human flora, various methods of drug susceptibility testing, different bacterial diseases, prevention and control, transmission, pathogenesis, laboratory diagnosis, prevention and control of fungal diseases.

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<b>CO5</b>	Summarize the role of resident flora and human host, Pathogenicity islands, methodology of drug susceptibility testing, various bacterial, viral and fungal disease .
<b>CO6</b>	Justify the routes of transmission of pathogens, how to bacteria enter the host, Methods of drug susceptibility testing, pathogenesis , treatment and control of bacterial ,viral and fungal diseases.

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**CO-PO Mapping**

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	1	1	1	2	2	1	2	2	2	2	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3	2
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

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Course code	: MBDS—102			
Course Name	: INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY			
Semester /Year	: I			
	L	T	P	C
	3	0	0	3

L - Lecture T - Tutorial P - Practical C - Credit

**Course Objectives: The objectives of this course are**

1. To make student aware to fermentor design and function.
2. To gain knowledge about media formulation and Inoculum development
3. To make student aware Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry

**Course Content**

**Unit I: Introduction to Industrial Microbiology**

Primary and secondary metabolites; Structure of fermentor/bioreactor; Types of fermentor/bioreactors; Scale up and scale down processes; Types of fermentation (Solid state, surface and submerged fermentation). Batch and continuous culture.

**Unit II: Basic Aspects of Fermentation**

Media formulation; Sterilization; Inoculum development; Effect of temperature, pH and high nutrient concentration on fermentation; Operational modes of fermentation (Batch, fed-batch and continuous); Downstream processing.

**Unit III: Microbial Strain Improvement**

Strategies for isolation and cultivation of desired microorganisms; Screening for the desired product; Strategies for strain improvement: Mutation, Protoplast fusion, Recombinant DNA technology, idea of Novel strategies. Preservation of cultures after strain improvement programme.

**Unit IV: Industrial Production Aspects Production of antibiotics**

( streptomycin, grieseofulvin), amino acid (Glutamic acid and lysine), Production of enzymes (Pectinase, amylase, lipase, protease, cellulase and xylanase), organic acids (Citric acid, acetic acid and lactic acid), ergot alkaloids and bioplastics (PHB and PHA). Antifoam agent.

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 M.P. Singh  
 Saha  
 Arun  
 Dny



## Unit V: Introduction to Quality Assurance and Validation

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Basic principles of quality control (QC) and quality assurance (QA); Guidelines for QA and QC (Raw materials, sterilization, media, stock cultures and products), ISO, WHO and US certification; Sterilization control and sterility testing; Validation study; LAL test; Sterility testing and bioassay; Application of Biosensors in pharmaceuticals.

### Text Books:

1. Crueger, W. and Crueger, A. Biotechnology: A text book of industrial microbiology. Sinauer Associates, Sunderland.
2. Reed, G. Prescott and Dunn's industrial microbiology. Globe Book services, London.
3. Demain, A. Land Davies, J.E. Manual of industrial microbiology and biotechnology. ASM Press, Washington, D.C.
4. Casida, J.E. Industrial microbiology. Wiley Eastern, New Delhi.
5. Patel, A.H. Industrial microbiology. MacMillan India Limited, New Delhi.

### Reference Books

1. Hershnerge, C.L., Queener, S. W. and Hedemen, Q. Genetics and biotechnology of industrial microorganisms. ASM Press, Washington, D.C
2. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication, Cambridg.
3. Stanbuty, P.F. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.
4. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London

### Course outcomes (COs):

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

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

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CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	2	3
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

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*Michael*  
*M.T. Gagnier*  
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Course code	: MBDL-105			
Course Name	: Lab Course I (Based on paper 1 & 2)			
Semester /Year	: I			
	L	T	P	C
	0	0	4	4

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

**Course Objectives: The objectives of this course are**

1. To learn the student Biosafety guidelines and biosafety levels.
2. To learn to perform about Isolation and biochemical characterization of pathogenic bacteria.
3. To learn to perform Determination of MIC and MBC concentration of antibiotics by broth dilution test.

**Course Content**

**CREDITS: 03**

1. Biosafety guidelines and biosafety levels.
2. Prevalence of pathogenic microorganisms in clinical sample.
3. Isolation and biochemical characterization of pathogenic bacteria.
4. Isolation and identification of fungal pathogens from clinical specimens.
5. Determination of antimicrobial susceptibility of pathogens by disc diffusion test.
6. Determination of MIC and MBC concentration of antibiotics by broth dilution test.
7. Isolation and screening of bacterial and fungal cultures for enzyme production.
8. Estimation of enzyme production by microbial culture *via* liquid state fermentation.
9. Estimation of enzyme production by microbial culture *via* solid state fermentation.
10. Media formulation for enhanced enzyme production by microbial culture *via* liquid and solid state fermentation.
11. Optimization of culture conditions for enhanced enzyme production by microbial culture *via* liquid and solid state fermentation.
12. Production of wine from fruit juice.
13. Monitoring of sugar reduction during wine production.
14. Estimation of alcohol concentration in wine.
15. Estimation of vicinal diketone in beer.
16. Improvement of strain for increased yield by U.V. mutagenesis.

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Course code	: MBDE--201			
Course Name	: Food and Dairy Microbiology			
Semester /Year	: II			
	L	T	P	C
	0	0	3	3

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

**Course Objectives: The objectives of this course are**

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

Course Content

**Unit I: Principles of Food Preservation**

Factors influencing microbial growth in food; Asepsis; Food preservation: Principles, Physical methods (Dehydration, freeze drying, heat and irradiation), Chemical methods (Chemical preservatives and food additives); Canning; Processing for heat treatment (D, Z and F values) and working out treatment parameters; Microbiological quality standards of food.

**Unit II: Contamination and Spoilage**

Characterization of contamination and spoilage of cereals, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, beer and wines; Spoilage of fermented foods and canned foods. Difference between contamination and spoilage.

**Unit III: Food borne Infections and Intoxications**

Bacterial and non bacterial infections and intoxications of *Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio*, *Yersinia*, *Listeria*, nematodes, protozoa, algae, fungi and viruses; Structure and functions of aflatoxins; Laboratory testing procedures.

**Unit IV: Food Safety and Quality Assurance**

Microbiological quality standards of food; Food control agencies and their

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regulations:

FDA, EPA, CDC and ISI; Good Manufacturing Practice; Plant sanitation (Employee health standards, waste treatment and disposal); Hazard Analysis and Critical Control Point (HACCP) system; Food Safety Act and Trade Regulations.

#### Unit V: Production of Fermented Foods

Industrial production methods of bread, cheese, fermented vegetables (Olives and cucumber), fermented dairy products (Acidophilus milk, cheese and yoghurt), single cell proteins, sauerkraut, meat and fishery products (Sausages and fish sauces); Production of oriental foods (Mycoprotein, tempeh, soyasauce, idli, natto and poi) and beverages (Vinegar, cider, sake and palm wines); Alcoholic beverages of Himalayan region; Genetically modified foods; Probiotics and its application.

#### Text Books:

1. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication, Cambridge
2. Frazier, W.C. and Westhoff, D.C. Food microbiology. Tata McGraw Hill, New Delhi.
3. Stanbuty, P.F. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.

#### Reference Books

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

#### Course outcomes (COs):

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

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CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	2	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	3	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	3	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: MBDE-203			
Course Name	: Elective-II Environmental Microbiology			
Semester /Year	: II			
	L	T	P	C
	3	0	0	3

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

**Course Objectives: The objectives of this course are**

1. To gain knowledge about abiotic and biotic Ecosystem.
2. To make student to aware pollution and its types.
3. To learn about microbial interaction.

**Course Content**

**Unit I: Fundamentals of Microbial Ecology**

Ecosystem; Biotic and abiotic components; Habitat and Niche; Population and guilds; Concept of community; Stability hypothesis; Intermediate-disturbance hypothesis; Concept of ecological niche; Ecosystem organization: Structure and functions, Primary production, Energy dynamics (Trophic

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organization and energy flow pathways); Microbial community dynamics: r and k strategies of population selection within communities.

## Unit II: Air and Aquatic Microbiology

Aerobiology: Droplet nuclei, Aerosol, Assessment of air quality, Solid and liquid impingement methods, Brief account of air borne transmission of microbes; Aquatic microbiology: Zonation and microbiota of fresh water (Ponds, lake and rivers) and marine habitats (Estuaries and deep sea), Upwelling and downwelling, Eutrophication, algal bloom, Food chain, Mechanism of dissolved organic matter production, Microbial assessment of water quality, Water purification.

## Unit III: Microbial Interactions

Positive and negative interactions amongst microbial populations: Cooperation, Neutralism, Commensalism, Synergism, Mutualism, Competition, Amensalism, Parasitism, Predation; Interactions between microorganisms and plants: Rhizobacteria, Mycorrhiza, Epiphytic and endophytic microorganisms; Interactions between microorganisms and animals: Predation on microorganisms by animals, Cultivation of microorganisms by animals for food and food processing.

## Unit IV: Pollution and its Control

Air pollution and its control: Sources, Major pollutants, Adverse effect on living organisms (Acid rain and its impact on ecosystem, greenhouse effect, global warming, ozone layer depletion and its effect, smog), Control through biotechnology (Deodorization, reduction in CO<sub>2</sub> emission, bioscrubbers, biobeds and biofilters); Water pollution and its control: Sources, Groundwater contamination, Wastes: Characterization of solid and liquid wastes, Solid waste treatment (Landfills, incineration, composting, anaerobic digestion and pyrolysis), Waste water treatment (Pretreatment, primary, secondary and tertiary treatment, Application of biofilm in waste water treatment); Environment impact assessment. Soil pollution; source and causes, soil salinity.

## Unit V: Impact of Microbes on Environment

Biodegradation of recalcitrant compounds: Pesticides and Petroleum; Bioremediation: *In situ* and *Ex situ* remediation, Bioremediation of oil spills; Bioaugmentation; Biomagnification; Biomineralization; Metal corrosion: Mode of deterioration, Microorganisms involved, Mode of prevention; Bioleaching of ore;

### Text Books:

1. Atlas, R.M. and Bartha, R. Microbial ecology: Fundamentals and applications. Benjamin/Cummings Science Publishing, USA.
2. Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. John Wiley and Sons, New York.

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Reference Books

1. Alexander, M. Microbial ecology. John Wiley and Sons, New York
2. Eldowney, S., and Waites, S. Pollution: Ecology and biotreatment. Longman, Harlow.
3. Baker, K.H. and Herson, D.S. Bioremediation. McGraw- Hill, New York.
4. Marshal, K.C. Advances of microbial ecology. Plenum Press, New York.

Course outcomes (COs):

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

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

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Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	3	3	2
CO3	2	3	2	2	2	1	1	2	2	2	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	2	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

**CO- PSO-PO Mapping:**

Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

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Course code	: MBDE- 203			
Course Name	: Elective-III AGRICULTURAL MICROBIOLOGY			
Semester /Year	: II			
	L	T	P	C
	3	0	0	3

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

Course Objectives: The objectives of this course are

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

Course Content

### Unit I: Abiotic and Biotic Components of Soil

Soil as a habitat for microorganisms; Soil enzymes and significance; Soil microbes; Influence of microbial metabolism on soil chemistry and humus formation; Organic matter dynamics in soil: Microbial decomposition of cellulose, hemicellulose and lignin, Factors affecting organic matter decomposition.

### Unit II: Rhizosphere and Rhizoplane Microorganisms

Rhizosphere; Rhizoplane; Composition of root exudates; Factors affecting exudation; Plant growth promoting rhizobacteria; Mycorrhiza; Rhizosphere effect; Factors affecting microbial community in soil; Mechanism of plant growth promotion: Mechanism of nitrogen fixation, Mechanism of phosphatesolubilization and phosphatemobilization, Mechanism of iron chelation, Production of plant growth promoting hormones from bacteria and fungi, Production of antibiotics by plant growth promoting microorganisms.

### Unit III: Plant Pathogens

General symptoms of plant diseases, Symptoms, causative organisms, disease

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cycle and control measures of plant diseases: Blight of rice, Citrus canker, Wilt of potato, *Pythium* seed rot, Grapes downy mildew, Potato early and late blights, Fusarial wilt, Wheat-smut and rust, Tikka leaf spot in groundnut, Common viral diseases of plants (Paddy, cotton, potato, tobacco, cauliflower, tomato and sugarcane); Biochemical and genetic basis of virulence in plant pathogens.

**Unit IV: Biocontrol Agents for Agriculturally Important Crop Plants**

Biopesticides: Source organisms (*Bacillus thuringiensis*, *Beauveria bassiana*, *Metarhizium anisopliae*, *Trichoderma* and Baculoviruses); Mechanism of biocontrol; Other means of pathogen control: Application of viral proteins in controlling viral diseases, Antisense RNA technology in disease control and RNAi in controlling plant pathogens.

**Unit V: Biofertilizers**

Isolation, purification, mass multiplication, inoculum production and method of application of biofertilizers. Bacterial biofertilizers: *Azospirillum*, *Azotobacter*, Phosphobacteria, *Rhizobium*, *Bradyrhizobium*, *Azorhizobium*, Mycorrhizal fertilizers, Algal biofertilizers; Storage, shelf life, quality control and marketing of biofertilizers.

**Text Books:**

1. Gupta, S.K, Biofertilizers, Kedar Nath Ram Nath, Meerut.
2. Subba Rao, N.S (1995). Soil microorganisms and plant growth Oxford and IB publishing co. Pvt. Ltd., New Delhi.

**Reference Books**

1. Kannaiyan, S. (2003). Bioethnology of biofertilizers, CHIPS, Texas.
2. Rai, M.K. (2005). Handbook of microbial biofertilizers, The Haworth Press, Inc .New York.
3. Reddy, S.M. et al. (2002). Bioinoculants for sustainable agriculture and forestry .Scientific Publishers.
4. Saleem, F. and Shakoori, A.R. (2012). Development of bioinsecticide. Lap Lambert Academic Publishing GmbH and Company.
5. Aggarwal, S.K. (2005). Advanced environmental biotechnology. APH publication

**Course outcomes (COs):**

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

CO1	Describe the role and affect of microorganism in agriculture.
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 M. T. Jang  
 Sam  
 Anurag  
 Dr. D. D. D.



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

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*Vidya*  
*ATC*  
*S. S.*  
*S. S.*  
*Agarwal*  
*D. S.*



**CO- PSO-PO Mapping:**

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	P S O 2	PS O3	PS O4
CO1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2
CO2	2	2	2	2	2	1	1	2	2	1	2	2	2	3	3	2
CO3	2	3	2	2	2	1	1	2	2	1	2	2	3	3	2	2
CO4	2	2	3	2	2	1	1	2	2	1	2	2	2	2	2	3
CO5	2	2	2	2	1	1	1	2	2	1	2	2	2	2	2	2
CO6	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	: MMDL204
Course Name	: Lab Course II (Based on paper Elective I,II and III)
Semester /Year	: II

	L	T	P	C
	3	0	0	3

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

**Course Objectives: The objectives of this course are**

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CO2	Interpretation of aerial photographs and data in GIS
CO3	Assess quality of food, drugs and environmental samples.
CO4	Characterize bacteria isolated from soil, food and environment.
CO5	Evaluate production of lactic acid in sauerkraut.
CO6	Production of biofertilizers ,mushroom and nannoparticles.

Course code	: MBPROJ-205
Course Name :	DISSERTATION
Semester/Year	:II Sem

	L	T	P	C
	0	0	10	10

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

**Course Objectives: The objectives of this course are**

1. Understand the fundamental framework of research process, designs and Methodologies.
2. To learn the student to Structure the methodology to accomplish organized conduct of interdisciplinary research.
3. To gain knowledge to publish the research outcome in scientific peer reviewed journal.

CO1	Observe a small research work to accomplish organized conduct of in various field.
CO2	Select and identify the methodology of project
CO3	Apply and Impart the outcome of their project in various seminars and conferences.
CO4	Apply and Present project work to a panel of experts.
CO5	Choose a Publish the research outcome in scientific peer reviewed journal.
CO6	Solve a research work by research methodology.

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## Course Content

### Topics for Dissertation

1. Drug Discovery
2. Drug Resistance
3. Infection and Immunity
4. Plant- Microbes Interaction
5. Microbial Diversity
6. Bioremediation
7. Prevalence and Characterization of Pathogenic Microorganisms
8. Food Adulteration and Food borne Pathogens
9. Fermented Foods
10. Strain Improvement
11. Enzyme Production
12. Microbial Biotechnology
13. Biomass and Bioenergy Production

Any other topic suggested by departmental committee may also be considered for the dissertation

Course code	: MBRS-206
Course Name:	–Seminar and Report Writing
Semester/Year:	IISemester

	L	T	P	C
		0	10	10

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

### Course Objectives: The objectives of this course are

1. To learn an innovative research to solve the problems faced in current scenario.
2. To understand independent and collaborative research projects.
3. To learn original research of significance and quality, for publications, presentations and original research proposals.

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**Course outcomes (Cos):**

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

<b>CO1</b>	Observe <b>innovative</b> research to solve the problems faced in current scenario.
<b>CO2</b>	Observe and Recognize the basic concept of reading of review literatue/research paper.
<b>CO3</b>	Apply ofadequatescientificunderstandingofthebasicconceptsiniinstrumentationused in research for both qualitative and quantitative analysis.
<b>CO4</b>	Analyzeand carry out independent and collaborative research projects.
<b>CO5</b>	Choose a original research of significance and quality, for publications, presentations and original research proposals.
<b>CO6</b>	Formulate a small research proposal and published in research article.

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