Programme Brochure
for
B.Sc.-M.Sc. (Integrated) Biotechnology
[4-year B.Sc.+ 1-Year M.Sc.]

[NEP-2020]

(I & II Semester Examination 2025-26)

(MSBU CAMPUS)

Maharaja Surajmal Brij University
Bharatpur

(Govt. of Rajasthan)

Department of Biotechnology
Institute of Applied Sciences
Maharaja Surajmal Brij University
Chak Sakeetra, Kumher, Deeg-321201, Rajasthan

(Prof. Archana Singh) प्रभारी आचार्य, अकादमिक (Dr. Anand Kumar) (Dr. Alok Sharma)

B.Sc.-M.Sc. (INTEGRATED) BIOTECHNOLOGY

(NEP 2020)

5-year Program

BIOTECHNOLOGY is a modern science that use living organisms, biological system or derivative to develop products and technologies to improve human life and the environment. It is a vast and evolving field that blends biology with technology, and its applications touch nearly every aspect of modern life from genetically modified crops to life-saving drugs.

Biotechnology, is the sector expanding into healthcare, agriculture, and renewable energy, supported by significant government investment and a growing number of startups aiming to reach $300 billion by 2030. Due to its wide applications across various industries, biotechnology professionals can work for multiple organisations, including government agencies, private companies, regulatory bodies, and clinical laboratories.

Why and Who Should Join?

This course is perfect for:

- ✓ Curious minds who love, live biology and want to apply it practically.
- ✓ Students aiming for careers in research, healthcare, agriculture, or pharmaceuticals.
- ✓ who passionate about curing diseases, feeding the world, or cleaning up the planet, this course equips you with the tools to make a difference.
- ✓ Future innovators who want to explore genetic engineering, synthetic biology, or environmental biotech, drug discovery etc.

B. Sc-M. Sc. (Integrated) Biotechnology is a Five-year degree course (with multiple entry and exit option), designed to give you a strong foundation in both theory and hands-on skills. It is a blend of multiple courses (both theory and practical) like cell biology, Molecular biology, genetics, Biochemistry, Microbiology, animal and plant biotechnology, bioinformatics, immunology, bioprocess to develop skilled manpower for future cutting-edge research, industry and academia.

The Department of Biotechnology established as a part of Institute of Applied Sciences, at Maharaja Surajmal Brij University in year 2023. The Course is running under self-finance scheme

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(Dr. Ashok Sharma)

(SFS). For more detail, please see University Brochure. Department currently enriched with well qualified faculties, Arvind Kumar (M.Sc. & Ph.D in Biotechnology; awards: DSKPDF, NPDF, Research Associate-III; winner CV Raman Prize-2025) (Asst. Professor & Course coordinator) and Dr. Alok Sharma (Asst. Professor) and other inter-departmental/visiting faculties.

B.Sc.-M.Sc. (Integrated) Biotechnology: Programme Structure-

Abbreviations: used in the text are

NEP: National Education Policy UG: Undergraduate PG: Postgraduate MJD: Major Disciplinary Course (Core Theory) MID: Minor Disciplinary Course (Elective) IDC: Inter Disciplinary Course AEC: Ability Enhancement Course (Language) SEC: Skill Enhancement Courses VAC: Value-Added Course SEM: Seminar DISS: Dissertation INT: Internship	IA: Internal Assessment EA: External Assessment CW: Class Work# MTE: Mid Term Exam EoSE: End of the Semester Exam ETE: End Term Exam M.M: Maximum Marks L: Lecture; T: Tutorial; P: Practical; S: Self Study #include attendance, assignment, class test/quiz, power point presentation, play learn by fun activities, etc.

DURATION OF COURSE

B.Sc.-M.Sc. (Integrated) Biotechnology course offered by Maharaja Surajmal Brij University is a NEP 2020 based 5-years UG-PG integrated programme. It has been divided into 8 (4-year) and 10-semesters (5-year) with a total of 200 Credits which provide multiple entry and exit options on successful completion of courses assigned at the end of each year as shown in Table 1 and 2.

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Table 1: Semester/Year and Exit Points

Year	Semesters		Exits Points
1st	Semester-I	Semester-II	Certificate Course in Biotechnology
2nd	Semester-III	Semester-IV	Diploma in Biotechnology
3rd	Semester-V	Semester-VI	Degree in B.Sc. Biotechnology
4th	Semester-VII	Semester-VIII	Degree in B.Sc. (H) Biotechnology
5th	Semester-IX	Semester-X	B.Sc.-M.Sc. (Integrated) Biotechnology

Table 2: Minimum Credit Requirements to Award Certificates/Diploma/Degree

Sl. No.	Broad Category of Course	Minimum Credit Requirement					
		UG Certificate (1-year)	UG Diploma (2-year)	UG Degree (3-year)	UG Honors (4-year)	UG Honors with Research Degree (4-year)	PG Degree (1-year)
1.	Major (Core Theory) (MJD)	08	30	60	80	80	100
2.	Minor (Elective) (MID)	08	16	24	44	32	48
3.	Multi/Interdisciplinary Course (IDC)	06	09	09	09	09	09
4.	Ability Enhancement Courses (AEC)	04	08	08	08	08	08
5.	Skill Enhancement Course (SEC)	06	09	09	09	09	09
6.	Value Added Course (VAC)	08	08	08	08	08	08
7.	Summer Internship	04*	04*	02	02	02	02
8.	Research Project/Dissertation	-	-	-	-	12	16
	Total	**40+4***	**80+4***	**120**	**160**	**160**	**200**

#The Honors students not undertaking research have to take 3 Courses for 12 Credits in lieu of a Research Project/ Dissertation.

*The students willing to exit with UG certificate required to complete Summer Internship (relevant Vocational Course) of 4 Credits during the summer vacation of the first year.

Conditions for Exit

- **UG Certificate:** Students who opt to exit after completion of the first year (2 semesters) and have secured 40 Credits will be awarded a UG certificate only if, in addition, they complete one vocational course of 4 Credits during the summer vacation of the First year. These

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students are eligible to re-enter in the degree programme within 03 years and complete the degree programme within the stipulated maximum period of 07 years.

- **UG Diploma:** Students who opt to exit after completion of the Second year (4 semesters) and have secured 80 Credits will be awarded the UG diploma only if, in addition, they complete one vocational course of 4 Credits during the summer vacation of the second year. These students are allowed to re-enter within a period of 03 years and complete the degree programme within the maximum period of 07 years.
- **UG Degree (3-year):** Students who wish to undergo a 3-year UG programme will be awarded UG degree in the Major discipline after successful completion of three years (6 semesters) securing 120 Credits.
- **UG Honors Degree (4-year):** Students who wish to undergo a 4-year UG programme will be awarded UG Honours degree in the major discipline on successful completion of four years (8 semesters) degree programme with 160 Credits.
- **UG-PG Integrated Degree (5-year):** Students who wish to undergo a 5-year UG programme will be awarded B.Sc.-M.Sc. (Integrated) Biotechnology degree in the major discipline on successful completion of five years (10 semesters) degree programme with 200 Credits.

LATERAL ENTRY

As per NEP, students have a choice of Lateral Entry (for those who completed 1st year with 44 Credits) into the Program of Study. UGC specifies that about 10% of seats over and above the sanctioned strength shall be allocated to accommodate the Lateral Entry students. The guidelines for Lateral Entry are as follows:

1. Lateral Entry for II Year B.Sc./ B.Sc. Honors in Biotechnology: Student should complete **UG Certificate Course with major subject as Biotechnology and minor subject as Biochemistry** from any University.
2. Lateral Entry for III Year B.Sc. / B.Sc. Honors in Biotechnology: Student should complete **UG Diploma Course in Biotechnology with minor subject as plant science and animal science** from any University.
3. Lateral Entry for IV Year B.Sc. (Honors) in Biotechnology: Student should complete degree in B.Sc. Biotechnology from any UGC recognized University.

Definitions, Eligibility, and Duration of the Programme: -

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- **Semester:** comprises minimum 90 working days and an academic year is divided into two semesters (6 month each).
- **Major disciplines (MJD)**: Major discipline is the subject specific compulsory subject and the degree will be awarded in that discipline. Students should secure the prescribed number of Credits (about 50% of total Credits) through core courses in the major discipline. All discipline specific major courses shall be designed for 04 Credits each with one/two additional hours or guidance of teaching at Tutorials/Practicals. UG programmes may be offered in a single major discipline or in Multiple Major disciplines giving equal weightage in Credits. For example, a B.Sc. course may be in a single discipline like B.Sc. (Biotechnology) or with multiple major disciplines like B.Sc. (Biotechnology, Microbiology, Bioinformatics & Genetics).
- **Minor discipline (MID)**: Minor discipline is the discipline or subject which are Allied/Specialization/Elective subjects to the Major discipline. These allied courses are expected to provide additional understanding of the subject in a specific focused area.
- **Inter-disciplinary course (IDC):** All undergraduate students are mandated to pursue 09 Credits worth of courses in such multi- disciplinary areas/Courses out of 09/10 NEP defined subjects. Universities/Colleges may identify any 03 multiple disciplinary streams listed below based on availability of resources and manpower.
  - ❖ Natural Sciences
  - ❖ Physical Sciences
  - ❖ Mathematics & Statistics
  - ❖ Computer Science/Applications
  - ❖ Data Analysis
  - ❖ Social Sciences
  - ❖ Humanities
  - ❖ Commerce & Management
  - ❖ Library Science
  - ❖ Media Sciences, etc.

  Students are expected to learn basic/introductory courses designed by other departments for this purpose. Colleges may list any 03 introductory courses (one each in natural Sciences, Physical Sciences, Humanities) for uniform adoption of all UG students.

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- **Ability Enhancement Courses (AEC):** All Undergraduate (UG) students are mandated to complete at least 08 Credits worth of Courses which focus on communication and linguistic skills, critical reading, and writing skills. These courses are expected to enhance the ability in articulation and presentation of their thoughts at workplace. Department/Colleges may design these ability enhancement courses tuned to the requirements of given major discipline.
- **Skill Enhancement Course (SEC):** These courses focus at imparting practical skills with hands-on Training. In order to enhance the employability of students, colleges are expected to design such courses that they deem fit for their students for better employment/entrepreneurship/career development, etc. Department/Colleges may also outsource the Skill Enhancement Courses to AICTE approved agencies for conducting short term Training Workshops, Skill India initiatives of GOI and approved Trades by Skill development of corporation are to be considered.
- **Value Added Courses (VAC):** Under NEP, the UGC has proposed for 6 to 8 Credits worth of common courses which are likely to add value to overall knowledge base of the students. These courses include:
  a) Understanding India
  b) Environmental Sciences/Education
  c) Digital and Technological solutions
  d) Health, Wellness, Yoga Education, Sports & Fitness

The course structure and coverage of topics are suggested by UGC in its draft documents. Universities/Colleges/UG Boards of Studies may design the methodology for conducting these value-added courses.

- **Summer Internship (2-4 Credits):** As per the UGC guidelines all UG students should be exposed to 4 to 6 week Summer Internship in an Industrial Organisations/Training Centres/Research Institution, etc. and training can be carried out during the summer term, especially by students who wish to exit after two semesters or four semesters of study. Regular courses may also be offered during the summer on a fast-track mode to enable students to do additional courses or complete backlogs in coursework. The department/management can decide the courses to be offered in the summer term depending on the availability of faculty and the number of students.

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- **Community Engagement and Service (CES) (2 Credits):** All UG students are also mandated to participate in a 15 days community engagement activity during their winter vacation between 5th and 6th Semesters. This community engagement activity is expected to expose the students to social problems of neighbourhood village students may prepare a report on the activities carried out for award of 2 Credits.

Internal Assessment, Examination Scheme, and minimum Credits to earn Diploma and Degree in Biotechnology:

1. The medium of instruction and examination shall be in English only. Regional Language (Hindi) medium may also be offered if feasible. The question paper shall be set in English. Bilingual question paper(s) may be provided, if possible. The students can write their answers in English/Hindi.

2. Assessment of students' performance shall consist of:

i. One credit is equivalent to 25 marks. Thus, four credit theory course will carry 100 marks. Out of 100 marks 30% marks shall be reserved for Internal Assessment (IA) [IA= (CW+MTE)] based on attendance, assignments, seminar/presentation & viva, and internal theory mid-term exam. The IA of every course will include at least three of the above components, and the weightage given to each of the components shall be decided by the individual teacher teaching/handling that course/paper. Any student who fails to participate in the IA exercises will be debarred from appearing in the End of Semester Examination (EoSE) i.e End Term Exam (ETE) in the specific course and no Internal Assessment marks will be awarded. His/her IA marks will be awarded in the next applicable semester only. No special classes will be conducted for him/her during other semesters.

ii. In case of Practical, Project work, etc., the marks will be divided in 20% for Internal and 80% for External exams (End-Term Exam).

iii. **Internal Test Scheme:** Head of the Departments will schedule the Mid-Term (semester) Exam for all courses during 08/09th week of start of classes. All faculty members are expected to conduct this Mid-Semester Exam for 2 hrs duration and evaluate, upload the marks to Controller of Examinations of University. Department/Colleges will preserve the answer books of Mid-Term exams until declaration of results by the University.

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iv. **Internal Assessment marks for Practicals / Project work / Internships subjects:**

Faculty member in-charge of Lab practicals shall evaluate the practical subjects for 20 marks.

v. **External Assessment (EA) & End-Term Exam: -**

Controller of Examinations (CoE) of Maharaja Surajmal Brij University will schedule the End-Term exams at the end of the semester for all theory and practical subjects.

A detailed Exam Time Table shall be circulated at least 15 days before the start of exams at the end of the Semester. Question Papers shall be set based on BOS approved syllabus. The breakup of end semester marks:

a) Theory subjects: (Section A and B) Question from all units of syllabus	80 marks
b) Practical/Internship/Project/ Field visit (based on work report/ Presentation/ Viva etc.	80 marks

vi. As per NEP regulations, the minimum passing marks is 50% (IA+ ETE taking together, however, Maharaja Surajmal Brij University regulations, **40% marks will be the minimum marks to avail certificate, diploma, degree in B.Sc. Biotechnology course and B.Sc. (Honors).**

vii. The duration of End-Term Exam shall be 3 hours. Each theory paper shall contain Part A and Part B.

viii. Part "A" of theory paper shall contain 08 Short Answer type Questions of 16 marks based on knowledge, understanding and applications of the topics/ texts covered in the syllabus. Each question will carry one marks for the correct answer.

ix. Part "B" of paper will consist of 04 questions from each unit with internal choice (except in case where a different scheme is specified in the syllabus) of 16 marks each. Questions may split in subsections with a total of 16 marks

x. Each Laboratory/SEC based lab work at end of the semester will be of six-hours duration and involve laboratory experiments/exercises.

xi. **Arrear exam:** A student who failed to secure 40% (minimum) marks in aggregates will be declared failed and he/she is eligible to take up supplementary exam by registering the said course in the following semester. All other candidates who failed due to shortage of attendance, those who are seeking to improve the grade shall repeat the course.

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EXAMINATION SCHEME

FOR THEORY PAPER

Maximum Marks: 100 (Internal: 20 & External: 80)

Passing Marks: in internal 08 out of 20 and external 32 out of 80 marks.

Internal Examination: Maximum Marks: 20

- Classwork (assignment/presentation/Attendance): 10 Marks
- Mid-Term Examination for 1 hour duration shall be taken: 10 Marks

External Examination (at end of the semester): Maximum Marks: 80, Exam-duration: 3 hrs

- ETE Examinations shall be in two sections.
- Section-A (short one line): each question carries 02 Marks,
- Section-B (long type): each question carries 16 Marks.

FOR PRACTICAL PAPER and/or SEC

Maximum Marks: 100: (Internal: 20 & External: 80)

INTERNAL EXAMINATION: Maximum Marks: 20

Components of Internal Evaluation (20 Marks)

1. Attendance/Classwork (10)
2. Practical Record + Performance during practical: 10 (5+5) Marks

END-SEMESTER PRACTICAL EXAMINATION: Maximum marks: 80

Components of External Evaluation (80 Marks)

1. **Part A:** Major Question (30 marks)
   a. Aim-2,
   b. Principle-5,
   c. Materials required-5,
   d. Procedure-15,
   e. Result-3
2. **Part B:** Practical Performance (20 Marks)
   a. Performance-10 Marks
   b. Interpretation of result-10 marks
3. **Part C:** Spotting (5 x 2 =10 marks)
   a. Identification-1 mark
   b. Description-1 mark
4. **Part D:** Practical Record and Viva: (10+10 Marks)

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EVALUATION OF WORKSHOP/INTERNSHIP /FIELD WORK

Maximum Marks: 100 (Internal: 20 & External: 80)

INTERNAL EXAMINATION: [Maximum Marks: **20**]

a) Internship Report/Field visit report etc.	10 marks
b) Demo note/Work dairy / etc.	10 marks

EXTERNAL EXAMINATION: [Maximum Marks: **80**]

a). Project Report	60 Marks
b) Oral Presentation cum Viva-Voce	20 Marks

EVALUATION & EXAMINATION FOR RESEARCH/PROJECT WORK (4/5th Yr)

Maximum Marks: 300/400 [Internal: 60/80 & External: 240/320]

INTERNAL EXAMINATION: [Maximum Marks: **60/80**]

a) Report evaluation	30/40 marks
b) Bibliography	10 Marks
c) Oral presentation etc.	20/30 marks

EXTERNAL EXAMINATION: [Maximum Marks: **240/320**]

a) Project Report	200/250 Marks
b) Oral Presentation	30/50 Marks
c) Viva-voce	10/20 Marks

Note: In-case of any improper evaluation of student's research work. A student may demand (in written) for re-evaluation of his/her research work to the Head of the Department/Institution or an equivalent competent authority of the Institution. The re-evaluation will be done in presence of at least one external subject experts, Dean of Science and Head of the Department or the committee constituted by Head and Dean. The expenses of the invited externals will be managed by the Institute as per rule and regulation led down by the University.

EXAMINATION SCHEME

FOR AEC COURSES

Maximum Marks: 50 (Internal: 10 & External: 40)

Passing Marks: in internal 4 out of 10 and external 16 out of 40 marks.

Internal Examination: [Maximum Marks: **10**]

- Class Work (Assignment/Presentation/Attendance): **05** Marks
- Mid-Term Examination of **05** marks.
- Question shall be of Multiple Choice Question CMCQ) type.
- Duration of exam shall of be of **30 mins**

External Examination (at end of the semester): [Maximum Marks: **40**].

- ETE Examinations shall be of 40 Marks.
- Question shall be of Multiple Choice Question (MCQ) type.
- Duration of exam shall of be of **2 hours**

EXAMINATION SCHEME

FOR VALUE ADDED COURSES (VAC)

Maximum Marks: 50

Mark's division according to paper opted by the students

Useful links for self-study/certificate courses: -

1. **MOOC** (Massive Open Online Course): are **free or low-cost online courses** from top Universities (like Harvard, Stanford) and companies, offering video lectures, assignments, and discussions for anyone to learn new skills for career growth, upskilling, or lifelong learning, with platforms like Coursera, edX, Udacity, with optional paid certificates.
Web Link: https://www.my-mooc.com/en/

2. **SWAYAM** (Study Webs of Active-Learning for Young Aspiring Minds): is a major initiative by the Government of India's Ministry of Education to provide **free online education.** Learners can access more than **4,000 courses** developed by expert faculty from top Indian Institutions like IITs, IIMs, and the UGC at no cost.
Web Link: https://swayam.gov.in/

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SEMESTER-WISE DETAILS OF B.Sc.-M.Sc. (INTEGRATED) BIOTECHNOLOGY COURSE

(First Year; Total Credits: 40 or 40+4*)

Sl. No.	Course category	Course Name	Course Code	Credits	Delivery Type			Total Hours	Weightage (%)			M.M
					L	T	P		CW	MTE	ETE	
Semester-I												
1.	MJD	Cell Biology	ABT 101	4	L	T	-	60	10	10	80	100
2.	MID	Introduction to Biotechnology	ABT 102	4	L	T	-	60	10	10	80	100
3.	IDC	Natural Science (Basic Botany)	ABT 103	4	L	T	-	60	10	10	80	100
4.	SEC	Biotechnological Laboratory Techniques -I	SEC 01P	4	-	-	P	60	10	10	80	100
5.	AEC	Hindi	AEC 01	2	L	-	-	30	05	05	40	50
6.	VAC*	Value Added Course	-	2	L	T	-	30	05	05	40	50
	Total Credits			**20**								**500**
Semester-II												
1.	MJD	Microbiology	ABT 201	4	L	T	-	60	10	10	80	100
2.	MID	Intermediary Metabolism	ABT 202	4	L	T	-	60	10	10	80	100
3.	IDC	Physical science (Science and Society)	ABT 203	4	L	T	-	60	10	10	80	100
4.	SEC	Biotechnological Laboratory Techniques -II	SEC 02P	4	-	-	P	60	10	10	80	100
5.	AEC	Hindi	AEC 02	2	L	-	-	30	05	05	40	50
6.	VAC*	Value Added Course	-	2	L	T	-	30	05	05	40	50
	Total Credits			**20**								**500**
	Total Credits of 1 year (Sem-I & II)			**40**								**1000**

*VAC: Students have choice to opt any one from the List of common Value Added Courses (VAC).

Note: Students opting to conclude their studies after the first year will receive a **Certificate in Biotechnology**, contingent upon achieving a **minimum of 40 Credits** with **additional 4 Credits** (earned from vocational course or internship, during the summer break of the first year).

SEMESTER-I

CELL BIOLOGY			Theory Paper
Course Code	Course Category	Credits	Max. Marks
ABT 101	**MJD**	**4**	**100 (IA:20 + EA:80)**

Course Objectives & Outcomes: Students will be able to

- Understand cell structures and functions, including organelles in plant, animal, bacterial cells, and viruses.
- Study cell interactions with their environment, focusing on membrane
- Dynamics, transport mechanisms, and surface differentiation.
- Learn the organization of the nucleus and chromosomes, understanding cellular inheritance and specialized structures.
- Understand the cell cycle, mitosis, meiosis, and regulation mechanisms with checkpoints and proteins.
- Explore cell signaling pathways, receptor mechanisms, apoptosis, and necrosis, understanding cellular communication and death.

UNIT-I: Cell Biology Basics

1. **History & Basic Theories** – Cell, Protoplasm and Organismal theory.
2. **Cell as the Basic Unit of Life** – Classification and characteristics of prokaryotic & eukaryotic cells.
3. **Ultrastructure** – Plant cell, Animal cell and Bacterial cell.
4. **Viruses** – Structure and basic features.

UNIT-II: Cell Membranes & Cytoskeleton

1. **Cell Wall** – Structure & function of bacterial and plant cell wall.
2. **Plasma Membrane** – Fluid mosaic model, membrane fluidity, membrane transport (uniport, symport, antiport and active/passive).
3. **Cell Surface Specializations** – Basement membrane, tight & gap junctions, desmosomes, hemidesmosomes.
4. **Cytoskeleton** – Microtubules, microfilaments and intermediate filaments.

UNIT-III: Cell Organelles & Bioenergetics

1. **Endomembrane System** – ER, Golgi, lysosomes and microbodies.
2. **Other Organelles** – Ribosomes, centrioles and basal bodies.
3. **Mitochondria** – Structure; respiratory chain organization; ATP formation.
4. **Chloroplast** – Structure; photophosphorylation.

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UNIT-IV: Nucleus, Chromosomes & Cell Division

1. **Nucleus Structure** – Nuclear membrane, nucleolus, chromatin organization.
2. **Chromosomes** – Chromatid, centromere, telomere, nucleosomes, euchromatin/heterochromatin, polytene & lampbrush chromosomes.
3. **Cell Division** – Cell cycle, mitosis, meiosis, checkpoints & regulatory proteins.
4. **Cell Signaling & Death** – Ligands, receptors (GPCR, RTK), apoptosis vs necrosis.

Suggested Readings:

1. E.D. P. De Robertis and E.M.F. De Robertis, Jr. (2012). Cell and Molecular Biology (8th edition). B.I. Waverly Pvt. Ltd., New Delhi.
2. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Dernell (2009). Molecular Cell Biology (4th edition). W.H. Freeman and Company.
3. P.S. Verma and V.K. Agarwal (2012). Concepts of Cell Biology. S. Chand & Company Ltd., New Delhi.
4. Bruce Alberts (2009). Essential Cell Biology (3rd edition). Garland Science.
5. Gerald Karp (2013). Cell and Molecular Biology: Concepts and Experiments (7th edition). John Wiley & Sons.
6. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick (2014). Molecular Biology of the Gene (7th edition). Cold Spring Harbor Laboratory Press.
7. David Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter (2015). Molecular Biology of the Cell (6th edition). Garland Science.
8. Thomas D. Pollard and William C. Earnshaw (2017). Cell Biology (3rd edition). Elsevier.
9. Geoffrey M. Cooper and Robert E. Hausman (2013). The Cell: A Molecular Approach (6th edition). Sinauer Associates.
10. Lehninger, Albert L., Michael M. Cox, and David L. Nelson (2017). Lehninger Principles of Biochemistry (7th edition). W.H. Freeman and Company.

INTRODUCTION TO BIOTECHNOLOGY			Theory Paper
Course Code	Course Category	Credits	Max. Marks
ABT 102	**MID**	**4**	**100 (IA:20 + EA:80)**

Course Objective: Biotechnology encompasses several disciplines. This course provides foundational concepts in a broad spectrum of disciplines, such as Cell Biology, Biochemistry, Microbiology, Fermentation, Molecular Biology, Genetic Engineering,

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and Instrumentation.

Outcomes:

1. To gain insight into the potential applications of Biotechnology for human welfare
2. To understand cellular architecture and comprehend the functioning of various biomolecules and enzymes
3. To compare and contrast various microorganisms and their role in fermentation processes
4. To explain the underlying mechanism of gene expression and to appraise the genetic engineering of organisms for human welfare.
5. To explain and translate separation, purification, and identification techniques for biomolecules in research.

UNIT-I: Introduction to Biotechnology

1. **Definition & Introduction** – Meaning of biotechnology and overview.
2. **Scope & Importance** – Role in agriculture, medicine, industry, environment.
3. **Old vs New Biotechnology** – Traditional vs modern molecular approaches.
4. **Applications & Commercial Potential** – Use in industries; growth of biotechnology in India.

UNIT-II: Basics of Cell Biology, Biomolecules, Enzymology & Microbiology

1. **Cell Types & Organelles** – Prokaryotic and eukaryotic cell structure and functions.
2. **Biomolecules** – General structure and function (Carbohydrates, lipids & proteins).
3. **Enzymes**: General structure and function.
4. **Microbes** – Characteristics of bacteria & fungi.
5. **Fermentation Basics** – Types of fermentation, culture methods & downstream processing.

UNIT-III: Basic Molecular Biology & Genetic Engineering

1. **DNA, RNA & Gene Structure** – DNA as hereditary material; RNA types.
2. **Gene Expression** – Transcription, translation & genetic code; central dogma.
3. **Recombinant DNA Technology** – Concept and basic steps.
4. **Plant Tissue Culture** – Principles and applications.

UNIT-IV: Basic Instrumentation in Biotechnology

1. **Microbial Techniques** – Isolation, cultivation, pure culture methods.
2. **Spectroscopy & Chromatography** – Basic principles and uses.
3. **Electrophoresis & Centrifugation** – Separation techniques.
4. **Microscopy & Autoradiography** – Types and applications.

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Suggested Readings:

1. Concepts in Biotechnology by CFA Bryce, D Balasubramanian. Publisher: Universities Press Cell and Molecular Biology by M Jacob. Publisher: CBS
2. Lehninger's Principle of Biochemistry by DL Nelson, MM Cox. Publisher: WH Freeman
3. Microbiology by MJ Pelczar, ECS Chan, NR Krieg Publisher: Tata McGraw Hill Molecular Biology of the Gene by JD Watson et al. Publisher: Pearson
4. Genetic Engineering by S Rastogi, N Pathak. Publisher: OUP
5. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology by A Hoffman, S Clokie. Publisher: CUP

BIOTECHNOLOGICAL LABORATORY TECHNIQUES-I			Practical
Course Code	Course Category	Credits	Max Marks
SEC 01	**SEC**	**4**	**100 (IA:20 + EA:80)**

Laboratory Exercises:

1. Basic calculations used in experimental biology
2. Microscopic techniques- light Microscopy
3. Microscopic examination of Cells (Microbial, animal and plant cells)
4. Cell counting method- animal cells by Heamocytometer
5. Mitosis in onion root tip
6. Karyotyping (demo).
7. Meiosis in Pollen mother cell of plants (demo)
8. Plasmolysis in onion.
9. Extraction and Characterization of starch.
10. Cell counting method- Microbes
11. Observation of permanent slides
12. Preparation of media for the growth of microrganisms.
13. Microbial calculation by Serial dilution method
14. Isolation of bacterial cells from soil and water
15. Isolation of fungal cells from bread, plants, soil etc
16. Raising fungal cell from hyphal and single spore
17. Reagent preparation (e.g buffers, and stock solutions etc.)
18. Any other practical based cell biology, botany, microbiology and biochemistry

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SEMESTER II

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MICROBIOLOGY			Theory Paper
Course Code	Course Category	Credits	Max. Marks
ABT 201	**MJD**	**4**	**100 (IA:20 + EA:80)**

Course Learning Outcomes: Students will be able to

- Define microbiology, its development and its significance in fields like healthcare and biotechnology.
- Describe microbial diversity, including classification and features of Archaea, Bacteria, Fungi, Algae, Protozoa, Viruses and Prions.
- Explain the ultrastructure of bacteria, including cell wall biosynthesis, cellular appendages and genetic mechanisms.
- Demonstrate microscopy techniques, including principles and applications of various types of microscopes.
- Understand microbial nutrition, growth, and control methods, including sterilization, disinfection and physical and chemical control methods.

UNIT-I: Microbial Diversity

1. **Basics, History & Scope** of microbiology.
2. **General features & classification** of Archaea, Bacteria, Fungi, Algae, Protozoa, Viruses, Prions.
3. **Characteristics of major microbial groups**—morphology & habitat.
4. **Differences between Prokaryotes and Eukaryotes** (structure & organization).

UNIT-II: Bacterial Ultrastructure & Genetics

1. **Bacterial cell structures** – cell wall (biosynthesis), cell envelope, capsules, slime layer.
2. **Appendages** – pili, fimbriae, flagella; cell membrane & inclusion bodies.
3. **Genetic material** – plasmid DNA vs chromosomal DNA.
4. **Bacterial Genetics** – conjugation, transformation & transduction.

UNIT-III: Microscopy & Staining

1. **Staining** – principles; simple vs differential staining.
2. **Light Microscopes** – bright field, dark field, phase contrast, fluorescence (principle & uses).
3. **Electron Microscopes** – TEM & SEM (instrumentation & applications).
4. **Microscopy instrumentation** – basic working and image formation.

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UNIT-IV: Microbial Nutrition, Growth & Control

1. **Nutritional types & media** – classification, media preparation & culture techniques.
2. **Microbial growth** – growth curve; aerobic & anaerobic culturing; lytic & lysogenic viral cycles.
3. **Isolation, preservation & maintenance** of microbes; biotic & abiotic factors affecting growth.
4. **Microbial control** – sterilization, disinfection, antisepsis; physical (heat, radiation, filtration, etc.) and chemical methods.

Suggested Readings:

1. M.J. Pelczar Jr., E.C.S. Chan, and N.R. Krieg, Microbiology, 5th edition (2001), Tata McGraw-Hill, New Delhi.
2. R. Ananthanarayanan and C.K. Jayaram Paniker, Textbook of Microbiology, 12th edition (2022), Universities Press, Hyderabad.
3. Lansing M. Prescott, John P. Harley, and Donald A. Klein, Microbiology, 10th edition (2017), McGraw-Hill Education, New York.
4. R.C. Dubey and D.K. Maheswari, A Textbook of Microbiology, 4th edition (2014), S. Chand & Company Ltd., New Delhi.
5. Gerard J. Tortora, Berdell R. Funke, and Christine L. Case, Microbiology: An Introduction, 13th edition (2018), Pearson, New York.
6. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, and David A. Stahl, Brock Biology of Microorganisms, 15th edition (2017), Pearson, Boston.
7. Joanne M. Willey, Linda M. Sherwood, and Christopher J. Woolverton, Prescott's Microbiology, 10th edition (2017), McGraw-Hill Education, New York.
8. James G. Cappuccino and Natalie Sherman, Microbiology: A Laboratory Manual, 11th edition (2019), Pearson, Boston.
9. Robert W. Bauman, Microbiology with Diseases by Taxonomy, 5th edition (2017), Pearson, Boston.
10. David Greenwood, Richard Slack, John Peutherer, and Mike Barer, Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control, 18th edition (2012), Churchill Livingstone, London.

INTERMEDIARY METABOLISM — Theory Paper

Course Code	Course Category	Credits	Max. Marks
ABT 202	**MID**	**4**	**100 (IA:20 + EA:80)**

Course Objective and Outcomes: Students will be able to

- Understand carbohydrate metabolism: glycolysis, fermentation, citric acid cycle, oxidative phosphorylation, gluconeogenesis, glycogen metabolism.
- Analyze amino acid metabolism: transamination, deamination, urea cycle, catabolism,

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biosynthesis.

- Evaluate lipid metabolism: fatty acid biosynthesis, oxidation, ketone bodies, cholesterol metabolism.
- Demonstrate comprehension of nucleic acid metabolism: biosynthesis, conversion, degradation, salvage pathways, regulatory roles.
- Identify and understand inborn errors of metabolism and their genetic and symptomatic characteristics.

UNIT-I: Amino Acid Metabolism

1. **General amino acid metabolism** – transamination, transamidation, deamination.
2. **Nitrogen excretion** – uric acid formation & urea cycle.
3. **Amino acid catabolism** – breakdown pathways & metabolic fates.
4. **Amino acid biosynthesis** –synthesis of Tryptophan & Methionine.

UNIT-II: Carbohydrate Metabolism

1. **Energy-yielding pathways** – glycolysis, fermentation, TCA cycle.
2. **ATP production** – oxidative phosphorylation & electron transport chain.
3. **Glucose synthesis & alternate pathways** – gluconeogenesis, PPP, glyoxylate shunt.
4. **Glycogen metabolism** – glycogenesis & glycogenolysis.

UNIT-III: Lipid Metabolism

1. **Fatty acid biosynthesis** – long-chain, unsaturated FAs; TAGs & phospholipids.
2. **Fatty acid degradation** – β-oxidation of saturated & unsaturated FAs.
3. **Other lipid pathways** – ketone bodies, cholesterol metabolism.
4. **Lipid handling in the body** – dietary lipid absorption & comparison of FA synthesis vs oxidation.

UNIT-IV: Nucleic Acid Metabolism & Metabolic Disorders

1. **Nucleotide synthesis** – purine & pyrimidine biosynthesis; salvage pathways.
2. **Nucleotide degradation** – breakdown to uric acid & urea; regulatory roles & non-enzymatic changes.
3. **Inborn errors of metabolism (carbohydrates)** – Diabetes mellitus I, Pompe's disease.
4. **Amino acid, lipid & nucleotide metabolism disorders** – Homocystinuria, CPS-I deficiency, Gaucher's & Tay-Sachs diseases, Lesch-Nyhan & Miller syndrome.

Suggested Readings:

1. Voet, D., Voet, J. G., & Pratt, C. W. (2018). Fundamentals of Biochemistry: Life at the Molecular Level (5th Edition). Wiley.

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2. Nelson, D. L., Cox, M. M., & Lehninger, A. L. (2017). Lehninger Principles of Biochemistry (7th Edition). W. H. Freeman.
3. Berg, J. M., Tymoczko, J. L., & Gatto Jr, G. J. (2021). Stryer's Biochemistry (9th Edition). W. H. Freeman.
4. Wilson, K., & Walker, J. (2019). Principles and Techniques of Biochemistry and Molecular Biology (8th Edition). Cambridge University Press.
5. Murray, R. K., Bender, D. A., Botham, K. M., Kennelly, P. J., Rodwell, V. W., & Weil, P. A. (2018). Harper's Illustrated Biochemistry (31st Edition). McGraw-Hill Education.
6. Garrett, R. H., & Grisham, C. M. (2016). Biochemistry (6th Edition). Cengage Learning.
7. Metzler, D. E., Metzler, C. M. (2001). Biochemistry: The Chemical Reactions of Living Cells (2nd Edition). Academic Press.
8. Mathews, C. K., van Holde, K. E., Appling, D. R., & Anthony-Cahill, S. J. (2012). Biochemistry (4th Edition). Pearson.
9. Devlin, T. M. (2010). Textbook of Biochemistry with Clinical Correlations (7th Edition). Wiley.
10. Berg, J. M., Tymoczko, J. L., Gatto Jr, G. J., & Stryer, L. (2015). Biochemistry (8th Edition). W. H. Freeman.

BIOTECHNOLOGICAL LABORATORY TECHNIQUES-II			Practical
Course Code	Course Category	Credits	Max. Marks
SEC 02	**SEC**	**4**	**100 (IA:20 + EA:80)**

Laboratory Exercises:

1. Microscopic Examination of Bacteria, Yeasts, and Fungi
2. Bacterial Motility Assay
3. Simple Staining of Bacteria
4. Gram Staining Procedure
5. Preparation of Solid, Liquid, and Semi-Solid Media
6. Techniques for Inoculation
7. Isolation and Maintenance of Pure Bacterial Cultures
8. Enrichment Culture Techniques
9. Microbial Growth Curve Analysis
10. Carbohydrate Estimation using Anthrone Method
11. Qualitative Analysis of Carbohydrates via Osazone Method

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12. Total Protein Estimation with Lowry's Method
13. Amino Acid Estimation using Ninhydrin Method
14. Total Cholesterol Estimation with Zak Method
15. Determination of Bile Salts in Urine
16. Measurement of Albumin Levels in Urine
17. Analysis of Unsaturated Fatty Acids
18. Assay for Amylase Activity (Microbial/ salivary).

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Multi/Inter-Disciplinary Courses

FOR UG PROGRAMMES

Semester – I:

Natural Sciences:

1) Herbal Nutrition
2) Basic Botany
3) Basic Zoology
4) Basic Microbiology
5) Fundamentals of Biotechnology

Semester – II:

Physical Sciences:

1) Electronics in Everyday Life
2) Chemistry in Everyday Life
3) Science and Society
4) Energy in Everyday Life
5) Basic Mathematics

Semester – III Humanities/Social Sciences/Applied Sciences:

1) Basic Economics Concepts and Measurement
2) Basics of Accounting
3) Commercial Geography
4) Food Biotechnology
5) Agricultural Biotechnology

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SEMESTER –I

Multi/Inter-Disciplinary Courses

Natural Sciences		Theory paper
Course Category	**Credits**	**Max. Marks**
IDC	**4**	**100 (IA: 20; EA: 80)**

1. HERBAL NUTRITION

COURSE OBJECTIVES:

- Acquire more knowledge about the common herbs, their nutritional properties and their regulations
- Gains more knowledge about the healing properties of common medicinal plants and their use in traditional health care systems
- Utilize these herbs as food and supplements

Unit I

Definition of herb, herbal Nutrition, Common herbs used in Indian Cuisine. Importance of medicinal plants –role in human health care–health and balanced diet.

Unit II

Cultivation methods–Crop protection–Harvesting–Storage and Protection–Marketing and utilization-Export of medicinally important (General aspects). Tulsi, Alovera, Turmeric, curry leaves, black pepper, thyme, garlic, Giloy. Nutritional content of common Indian herbs, Phenolic content, Carotenoids, minerals and essential oils. Significance of common herbs, culinary herbs, cooking methods of herbs – Basil, Cherril, Chimes, Cilantro, Dill, Mint, Oregano, Parsley, Rosemary, Sage, Tarrangon, Thyme, Lemongrass

Unit III

Nutritive and medicinal value of common vegetables and fruits – Bottle gourd, white ash gourd, plantain, bamboo shoot, bitter gourd, spinach, moringa leaves, amaranth. Papaya, Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate.

Unit IV

Common herbal dietary supplements, possible side effects and drug interactions– Black cohosh, Cranberry, Curcumin, Echinacea, Garlic, Ginkobiloba, Ginseng, Goldenseal, Green tea extract, Kava- kava, Milk thistle, Sawpal, Etto, St. John's wort, Valerian, Pharma cookies with herbal supplements.

Suggested Readings:

1. Gokhale,S.S.,C.K.KokateandA.P.Purohit(1994)Pharmacognosy.NiraliPrakashan.Pune
2. Faroogi,A.A.,andB.S.Sreeramu(2004).CultivationofMedicinalandAromaticCrops.University Press (India)Pvt. Ltd., Hyderabad.

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3. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi,India,2002.
4. Herb Nutrient and drug interactions: Clinical implications and therapeutic strategies (2008) Mitchell Bebel Stargrove Jonathan Treasure DwightL. Mc Kee, Published by Elsevier-Health Sciences Division

Weblinks

1. Natural Medicines Comprehensive Database. Available at http://www. naturaldatabase.comlastaccessedonApril2,2013
2. https://www.aafp.org/pubs/afp/issues/2017/0715/p101.html

2. BASIC BOTANY

COURSE OBJECTIVES: On successful completion of the course, students will:

- Understand the cell and its types with emphasis on plant cells
- Understand the major groups of plants.
- Understand the concept of ecology and biodiversity.
- Understand the importance of plants and their role in human life.

Unit I:

Cell and Anatomy: Introduction to cell and its types - Prokaryotes and Eukaryotes; Study of plant cells; Introduction to tissues - simple and complex; Study of Leaf - monocot and dicot; Structure and function of flower.

Unit II:

Plant Diversity: Five Kingdom concept; Study of major groups - Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperm and Angiosperm (only general characteristics). Ecology: Concepts of ecology; Structure and function of ecosystem; Trophic organization - food chain and food web; Ecological pyramid

Unit III:

Ecosystem Types: Ecosystem types in India; Case study of any one of the following - forest ecosystem, aquatic ecosystem (marine or freshwater) and mountain ecosystem. Concept of biodiversity hotspot.

Unit IV:

Plants and Human Affairs: Important vascular plants and products used as food, textiles and medicines, oils and perfumes; Study of harmful plants; Advantages and disadvantages of genetically modified plants.

Suggested Readings:

1. Campbell NA, Reece JB (2008) Biology, 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Evert RF, Eichhorn SE (2012) Raven Biology of Plants, 8th edition, New York, NY: W.H. Freeman and Company.

3. Singh V, Pandey PC, Jain DK (2001) A Text Book of Botany. Meerut, UP: Rastogi and Co.
4. Odum EP (2005) Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
5. Ambasht and Ambasht (2002) A text book of Plant Ecology. CBS publisher and Distributors.

3. BASIC ZOOLOGY

Course Objective and Outcome: The objective of the paper is to understand biodiversity, habitat, adaptation organization of animals and their economic importance. At the end of the course the students will understand the significance of animals in the biosphere and their economic importance and need forthe conservation of their habitats

Unit I
General classification of Animal Kingdom – general characteristics of Invertebrate, Chordata and Vertebrata.

Unit II
Parasites of human – Plasmodium, Tapeworm. Vector and vector control – mosquitoes.

Unit III
Economic importance of insects – honey bee, silk worm. Economic importance of Mollusca – pearl oysters, shells. Fish culture.

Unit IV
Geographical distribution of animals; Land and aquatic animals; Corals and coral reefs; Importance and threats to biodiversity.

Suggested Readings: -

1. Arumugam N. (2017). Developmental Zoology, Saras Publication, Nagarcoil, Tamilnadu.
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata.
3. Nair NC, Leelavathy S, SoundaraPandian N and Arumugam N. (2013). A Text Book of Invertebrates, Saras Publication Nagercoil, Tamilnadu.
4. Thangamani A, Prasannakumar S, Narayanan LM, Arumugam N. (2013). A Text Book ofChordates, Saras Publication, Nagercoil, Tamilnadu.

4. BASIC MICROBIOLOGY

COURSE OBJECTIVES: To understand the basics of microbiology and to know the role in environment. To provide fundamental understanding of the microbial world, basic structure and functions of microbes, metabolism, nutrition, their diversity, physiology and relationship to environment and human health. To impart practical skills of isolation and manipulating conditions for their propagation. To ensures the students to understand about the structure and function of microorganisms.

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Unit I

Microbial Diversity: Basics of microbiology, History and Scope of microbiology, General features and Classification of Archaea, Bacteria, Fungi, Algae, Protozoa, Viruses and Prions. Differences between prokaryotic and eukaryotic organisms. Ultrastructure of Bacteria: Sub-cellular structures - Cell wall of bacteria and its biosynthesis, Cell envelope - capsule and slime layer, Cellular appendages - pili, flagella and fimbriae, Cell membrane, inclusion bodies, Plasmid DNA and chromosomal DNA. Bacterial genetics - conjugation, transduction (generalized and specialized), and transformation.

Unit II

Microbial Nutrition: Classification of microorganisms based on their nutritional types, Preparation of media, types of media, culturing of microbes, Microbial growth curve, viral replication: lytic and lysogenic cycles, Isolation, preservation and maintenance of microorganisms, Aerobic and Anaerobic culturing of bacteria, Effect of biotic and abiotic factors on the growth of organisms.

Unit III

Microscopy: Staining - Principles and types of staining (simple and differential) Microscopy -Instrumentation, principles and applications of light microscopes (bright field, dark field, phase contrast, fluorescent microscopes) and electron microscopes (transmission and scanning electron microscopes).

Unit-IV

Microbial Control: Sterilization, disinfection, antisepsis, fumigation. Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), desiccation, osmotic pressure, radiation, UV-light, electricity, ultrasonic sound waves, filtration. Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization)

Suggested Readings:

1. M.J. Pelczar Jr. E.C.S. Chan and N.R. Kreig, Microbiology (5th edition), Tata MaCraw-Hill, New Delhi;
2. R. Ananthanarayanan. and C.K.Jayaram Panickar, Text book of Microbiology (9th edition), Orient Longman Publications, New Delhi
3. Lansing M. Prescott, John. P. Harley, Donald A. Klein, 1999. Microbiology (9th edition) WCB MaCraw-Hill, New York.
4. Sundararajan S (2003). College Microbiology, revised edition, Vardhana publications, Banglore.
5. R.C. Dubey, D. K. Maheswari, A Text book of Microbiology (2005), S. Chand & Company Ltd. New Delhi.

5. FUNDAMENTALS OF BIOTECHNOLOGY

COURSE OBJECTIVES: This course introduces the basics and fundamental concepts of biotechnology that covers the diversity of life, different kingdoms of living life, as well as applications of biotechnology in several fields. The students will be able to learn the basics biology,

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classification of the living organisms, nomenclature, and anatomy of different living systems. Also, they will be learned cell biology and application of biotechnology.

Unit I

Biodiversity and Classification: Classification of the living organisms -five kingdom classification concepts. Salient features of animals-non-chordates up to phylum level and chordates up to class level; salient features of plants -Angiosperms up to class level.

Unit II

Structural arrangements of animal and plant systems: Anatomy and functions of animal organs-digestive, circulatory, respiratory, nervous, and reproductive. Anatomy and functions of dicots and monocots plants. Cell-Fundamental unit of life: Differentiate between plant and animal cell; cell envelope; cell membrane, cell wall. Cellular organelles - structure and function; endoplasmic reticulum, Golgiapparatus, lysosomes, vacuoles, mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles; nucleus.

Unit-III

Human Diseases and Public Health Issues: Pathogens and parasites causing human diseases (dengue, chikungunya, dengue, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ring worm) and their control; cancer, diabetes, HIV and AIDS; Adolescence - drug and alcohol abuse.

Unit IV

Biotechnological Applications: General perspectives of Biotechnology: Genetic engineering applications of biotechnology. Application of Biotechnology in health and agriculture: Production of Human insulin and vaccines.

Suggested Readings: -

1. The Cell: A Molecular Approach. 2019, 8th Edition, Oxford University Press, Author: Geoffrey Cooper.
2. Biotechnology Fundamentals, 2017, 2nd Edition, CRC Press, Author: Firdos Alam Khan.
3. Life: The Science of Biology, 2012, 10th Edition. Authors: David E. Sadava, David M. Hillis, H. Craig Heller and May Berenbaum.
4. Biology of Plants, 2005, 7th Edition, New York: W.H. Freeman and Company. ISBN 0- 7167-1007-2 Authors: Raven Peter H, Evert Ray F and Eichhorn, Susan E.
5. General Microbiology, 2007, 5th edition, MacMillan Press. Authors: Stanier R. Y, Adelberg E.A and Ingraham J. L

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SEMESTER –II

Multi/Inter-Disciplinary Courses

Physical Science		Theory paper
Course Category	**Credits**	**Max. Marks**
IDC	**4**	**100 (IA: 20; EA: 80)**

1. ELECTRONICS IN EVERYDAY LIFE

Course Objectives and Outcomes: This course aims to introduce a non-specialist student to the world of digital and smart devices thenanoscience and nanotechnology behind it, all covering the following topics.

UNIT I:

- Binary system of numbers.
- Difference between analog and digital systems of electronics.
- Concepts of memory (bits, bytes, speed).

UNIT II:

- Different digital devices: desktops, tablets, laptops, flash drives, printers, scanners(components operation and communication).
- Introduction to sensors.

UNIT III:

- Smart devices: Touch and voice-enabled devices (such as phones, tablets, ATMs, etc.).
- Technologies of inter-device communication.

UNIT IV:

- Innovative applications, societal impact, and barriers to implementation.
- Future electronic devices.
- Introduction to nanoscience and nanotechnology

Suggested Readings:

1. Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson
2. Education
3. Stan Gibilisco, Teach Yourself Electricity and Electronics, McGraw-Hill
4. Edward L. Wolf, Quantum Nanoelectronics, Second Edition, Wiley
5. Getting Started in Electronics by Forrest M. Mims
6. Electronics For Dummies by Shamieh Cathleen, Wiley, 2019
7. Consumer Electronics by S P Bali, Pearson, 2008
8. Handbook of Biomedical Instrumentation, R S Khandpur, Tata Mc Graw Hill, 2014
9. Emerging Trends in Electronics Vijay G. Yangalwar Nirali Prakahshan Publishers, 2020
10. Paul Horowitz The Art of Electronics Cambridge University Press; 1st edition, 2020.

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2. CHEMISTRY IN EVERYDAY LIFE

Course Objectives: Learn about food adulteration, food additives and artificial sweeteners, saccharin, cyclomate and aspartate in the food industries. Understand the chemistry of soaps and detergents and their action. Know about the ingredients in commonly used cosmetics and perfumes. Gain knowledge about glasses and ceramics and their properties. Learn the nature of the plastics used in everyday life and natural substitution for plastic

Unit I:
Food additives: Functional food additives and its importance, food adulteration, detection of food adulterations, food safety laws and fssai regulations. Food colours-permitted and non- permitted – Flavours – natural and synthetic, artificial sweeteners, toxic effect of additives.

Unit II:
Soaps and Detergents: Soaps and Detergents – saponification, classification, cleansing action of soap, manufacturing process, additives, fillers, flavours, bleaching agents and enzymes used in commercial detergents, environmental hazards. Cosmetics and perfumes: Cosmetics and perfumes – classification, ingredients and regulations, bathing oils, face creams, talcom powder, skin products, hair dyes, shaving cream, shampoo, conditioners, nail polish, deodorants, antiperspirants, oral hygiene products, toxic effect of cosmetics.

Unit III:
Glasses and ceramics: Glasses and ceramics – classification, manufacturing process, composition and properties of glasses, soda glass, borosilicate glass, coloured glass, photosensitive glass, armoured glass, safety glass, Important clays and fledspar, plasticity of clay, ceramic and its types, white pottery, glazing, applications.

Unit IV:
Paper & Plastics: Plastics in daily use. Polymerization process (brief). Thermosetting and thermoplastic polymers. Use of PET, HDPE, PVC, LDPE, PP, PS, ABS, and others. Recycling of plastics. Biodegradable plastics. Environmental Hazards of plastics. Paper news print, writing paper, paper boards, cardboards. Organic materials, wood, cotton, Jute, coir – International Universal recycling codes and symbols for identification.

Suggested Readings:

1. Food – The Chemistry of its components, T.P. Coultate,. Royal Society of Chemistry London, 2001.
2. Engineering Chemistry, Shashi Chowla, DanpatRai & Co., 2017.
3. Industrial Chemistry, B.K. Sharma, Krishna Prakashan Publishers, 2012.
4. Understanding Chemistry, CNR Rao, Universities Press, 1999.
5. Engineering Chemistry, Jain and Jain, Darpat Rai Publication, 17th Ed., 2015.
6. Chemistry of cosmetics, Kumari R, Prestige publications, 2018.

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3. SCIENCE AND SOCIETY

Unit I

Manhattan project and definition of Modern and Ancient science in words of Prof. J. R. Oppenheimer. The first science Texts. The first theory of evolution and the 1st use of mathematics to measure the universe, nature, culture, and science.

Unit II

The birth of scientific methods refutation of ancient authorities through observation and experimentation. Instruments and new concepts, Rules of reasoning

Unit III

The laws of new science, two different theories of earth's present form, Unanswered questions- calculating the age of the earth, Continental drift. The first systematic attempt to describe the history of life, the origin of species, the laws of heredity, cell-level discoveries, mysteries of inheritance, Darwinist reductionism, relativity, quantum jumps, the big-bang, butterfly effect

Unit IV

Distinction between heat and temperature – Evolution of temperature measurements – Kelvin's absolute temperature – Concept of triple point of water – Three laws of thermodynamics.

Suggested Readings:

1. Story of Science From writings of Aristotle to the Big Bang Theory by Susan Wise Bauer, W.W. Norton and Company, 2015.
2. Tantra Sangrah of Nilakantha Somayaji by K Ramaswamy and M S Sriram, Hindustan Book Agency, 2011.
3. Hindu Astronomy by W. Brennand, (Caxton Publication India, 1998).
4. Indian Astronomy: Concepts and Procedure by Dr. S. Balachandra Rao.
5. Origin of Life by Freeman Dyson, (Cambridge University Press).

4. ENERGY IN EVERYDAY LIFE

Course Objectives:

- Understand the importance of energy.
- Understand the human pattern of energy consumption Understand the energy related environmental problems.
- Learn about the possible hostile-free alternative energy sources Understand the relevance between energy and economy.

Unit I

Energy: Introduction to Energy, atoms, energy - atom interaction, energy consumption, units of energy - Energy sources: solar energy, geothermal energy and nuclear energy - bioenergy - wind energy- ocean energy and fossil fuels - human patterns of energy consumption: internal consumption and external consumption, Global energy cycle.

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Unit II

Fossil Fuel and Energy conversion: Fossil fuels and their types, energy content and energy potential, energy capacity measurement, energy conversion, conversion efficiency, Global potentials of fossil fuels and supply chain - origin of pollution - types of pollution and their impact on daily life-nexus between energy, environment and sustainable development.

Unit III

Ecology and Environment: Concept and theories of ecosystems, - energy flow in natural and man-made ecosystems. Examples of natural and manmade ecosystems - agricultural, industrial and urban ecosystems-sources of pollution from energy technologies and its impact on atmosphere: air, water and soil - environmental laws on pollution control.

Unit IV

Pollution free renewable energy Technologies: Solar Energy- potential, energy conversion through photosynthesis, Photovoltaic conversion and solar thermal energy conversion. Wind Energy: potential and energy conversion systems. Ocean Energy: potential and energy conversion principles Bioenergy: resources and types. Energy and Economy: Energy and Economics: gross domestic product (GDP) and energy- energy market and society - energy efficiency - exergy - exergy and economics - energy: security- equity - environmental sustainability index and global measure.

Suggested Readings:

1. Energy and Environment, (Eds.) Loulou, Richard; Waaub, Jean- Philippe; Zaccour, Georges (2005).
2. Energy and the Environment, Ristinen, Robeti A. Kraushaar, Jack J. AK.raushaar, Jack P. Ristinen, Robert A., 2nd Edition, John Wiley, (2006)
3. Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, (2000).
4. Solar Energy: principles of Thermal Collection and Storage, S.P. Sukhatme, Tata McGraw-Hill (1984).
5. Y. Goswami, F. Kreith and J. F. Kreider, Principles of Solar Engineering, Taylor and Francis, Philadelphia (2000).
6. Wind Energy Conversion Systems, L.L. Freris, Prentice Hal 1990.
7. Geothermal Energy: From Theoretical Models to Exploration and Development by Ingrid Sober and Kurt Bucher, Springer, 2013.
8. Ocean Energy: Tide and Tidal Power by R. H. Charlier and Charles W. Finkl, Springer 2010
9. Energy Economic by Peter M. Schwarz, Routledge publications (2018).

5. BASIC MATHEMATICS

Course Objectives:

- Learn linear systems, matrices, dot product, and matrix transformations.
- Solve linear systems using row echelon forms, polynomial interpolation, and matrix inversion.
- Understand logic, truth tables, algebra of propositions, and set operations.
- Apply principles of inclusion-exclusion, addition/multiplication rules, and pigeonhole principles.
- Learn permutations, combinations, and elementary probability.

Unit I:
Linear System – Matrices – dot Product – Matrix multiplication – properties of Matrix operations – Matrix transformation.

Unit II:
Solution of linear system of equations – row echelon form – reduced row echelon form – Polynomial interpolation – inverse of a matrix – linear systems.

Unit III:
Logic – truth table – algebra of propositions- logical arguments – sets- operations on sets.

Unit IV:
Principle of inclusion – exclusion – the addition and multiplication rules – pigeonhole principles. Permutations – Combinations – Elementary Probability.

Suggested Readings:

1. Bernard Kolman, Dred. R. Hill, Introductory Linear Algebra, 8th edition – peasson, India 2011.
2. Edgar G. Goodaire, Michael. M. Parmenter, Discrete Mathematics with Graph Theory, 3e PHI, India, 2011.

SEMESTER–III

Multi/Inter-Disciplinary Courses

Humanities / Social Sciences/ Applied Sciences		Theory paper
Course Category	Credits	Max. Marks
IDC	3	100 (IA: 20; EA: 80)

1. BASIC ECONOMIC CONCEPTS AND MEASUREMENT

Unit I
Principles of Economics Economic problems – Economics and household management – Scope of economics. Optimization with constraints in economic analysis - Ten basic Principles of Economics - Microeconomics vs Macroeconomics – Normative and Positive Economics - Economic systems.

Unit II
Concepts in Microeconomics Basic concepts and measurement in consumer analysis: Utility, tastes and preferences, types of goods, income, wealth, prices of goods and services, budget constraint, indifference curve, utility maximization, elasticity – Basic concepts and measurement in producer analysis:

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Unit III

Labour, Capital, technology, factor productivity, revenue, cost, profit, returns to scale, economies and diseconomies of scale, - Different market structure and market Equilibrium - Market imperfections and externalities.

Unit IV

Concepts in Macroeconomics Measurement of standard of living and national income accounting – circular flow of income- major socioeconomic indicators, cost of living indicators – key macroeconomic variables: saving, investment, interest rate, money, inflation, balance of payments, foreign exchange rate, labour force and unemployment rate, Evolution of macroeconomic thinking: An overview

Suggested Readings:

1. Abel, Bernanke and Croushore, Macroeconomics, Pearson Education, 8th Edition, 2013.
2. Case, K.E. and Fair, R.C, Principles of Economics, Pearson Publisher, 8th Edition, 2013.
3. Dornbusch, R., Fischer, S. and Startz, R. Macroeconomics, Tata McGraw Hill, 12th Edition, 2018.
4. Gregory Mankiw, Principles of Economics,
5. Samuelson and Nordhaus, Economics, TATA McGraw Hill, 20th Edition, 2019

2. BASICS OF ACCOUNTING

Course Objectives:

- To understand the basics Accountancy.
- To know the fundamental concepts of Cost Accounting and Management Accounting
- To gain the basics of Accounting Application package.

UNIT I:

Accounting – Introduction-Meaning-Accounting and book keeping distinguished- objectives of accounting- Branches of accounting-accounting concepts and conventions- accounting standards in India.

UNIT II:

Double Entry System of Book Keeping -Journal-Ledger-preparation of Trial balance- rectification of errors - Cash book and Petty cash book. Preparation of Trading account- Preparation of Profit and loss account and Balance sheet- Final accounts with simple adjustments

UNIT III:

Financial Statement Analysis: Nature, significance and Types – Ratio Analysis and Cash Flow Analysis. Basics of Application Package-Tally, SAP, Excel programming.

UNIT IV:

Basics of Cost Accounting – Basic Concepts- Elements of cost – prime cost – works cost – cost of production –Preparation of cost-sheet: Computation of total cost, total revenue and profit/loss.

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Suggested Readings:

1. S.N. Maheswari, "Advanced Accountancy Vol I", Vikas Publishing
2. R.L. Gupta, "Advanced accounting", S. Chand & Co. New Delhi
3. Pillai and Baghawati, "Cost Accounting"
4. Jain and Narang, "Cost Accounting", Kalyani Publications
5. T.S. Reddy & Murthy, "Financial Accounting"
6. Jain & Narang, "Financial Accounting"
7. M. C. Shukla & T.S.Grewal, "Financial Accounting"

3. COMMERCIAL GEOGRAPHY

Unit I

Introduction to Commercial Geography - a. Meaning and Definition of Commercial Geography, b. Nature, Scope and Development of Commercial Geography, c. Importance of Applied Commercial Geography, d. Approaches to the study of Commercial Geography. Economic Activities in the Geographical Environment - a. Basic Economic Activities of Man Geographical Environment - i. Primary, ii. Secondary, iii. Tertiary, iv. Quaternary, v. Quinary
b. Factors affecting Economic activities of Man - i. Physical or Natural ii. Cultural or Human. c. Economic Resources -i. Meaning, Importance and Types of Resources, ii. Classification of Resources. Natural –i. Renewable, Non- Renewable, etc., ii Man Made Resources – Quantitative and Qualitative iii. Major Resources- Water, Soil, Forests, Energy (w.r.t. related economic and commercial activities), iv. Crises and Conservation of Resources.

Unit II

Human Resources - a. Meaning, Characteristics, Advantages and Disadvantages of - i. Over population, ii. Under population, iii. Optimum population. - b. Contemporary Issues of Population and Development, i. Dependency Ratio, ii. Human Development Index (HDI), iii. Migration and its effects, - c. Major Population Characteristics of India. Industry and Economic Development, a. Role of Industry in Economic Development, i.Classification of Industries, ii. Factors affecting Industrial Location, iii. Weber's theory of Industrial Location - b. Major Industries in India- i. Agro Based – Sugar, Cotton Textile, ii. Assembly line Based – Automobile, iii. Footloose and I.T. Industry, c. New Industrial Policy in India.

Unit III

Trade, Transport and Communication - a. Types of Trade, Factors affecting and Communication Trade, Balance ofPayments for India, Major Trade Blocs and the role of W.T.O. in International Trade, - b. Classification of various means of Transport. Advantages and Disadvantages.

Unit IV

Latest developments in India for: i. Land Transport (Road and Railway), ii. Water Transport (Inland and Oceans), iii. Air Transport . Types of Communications and their use in Commerce, i. Use of telecommunications, ii. Internet, iii. Mobile phones in Trade.

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Suggested Readings:

1. Hartshorne T. N. & Alexander J.W., (1994), Economic Geography, Prentice Hall, New Delhi.
2. Wheeler J. O. et., at (1995), Economic Geography, John wiley, New York.
3. Robortson D., (2001), Globalization and Environment, E. Elgar Co., U.K.
4. Saxena, H. M., (1990), Marketing Geography, Rawat Publication, Jaipur.
5. Khanna K. K. & Gupta V. K., (1982), Economic and Commercial Geography, Sultan Chand,New Delhi.
6. Commercial Geography – Sir Dudley
7. Stamp Commercial Geography – E.C. K. Gonner, Trieste Publishing Human and Economic Geography – Goh Cheng Leong & Gillian Morgan, Oxford University Press IndianEconomy (Datt & Sundaram) – Gaurav Datt & Ashwani Mahajan, S.Chand and Company.

4. FOOD BIOTECHNOLOGY

Course Content:

UNIT I: Principles of Food Preservation & Microorganisms

1. **Microorganisms in Food:** Role in food and beverage industry, contamination, spoilage, and chemical changes.
2. **Factors Influencing Growth:** Temperature, moisture, pH, oxygen, and asepsis in food handling.
3. **Preservation Principles:** Physical methods: dehydration, freeze-drying, heat, irradiation. Chemical methods: preservatives and additives.
4. **Heat Treatment Parameters:** D, Z, and F values; calculation of treatment parameters; microbiological quality standards.

UNIT II: Contamination, Spoilage & Fermentation Biotechnology

1. **Food Contamination & Spoilage**: Cereals, vegetables, fruits, meat, dairy, fish, seafood, beer, wines, fermented and canned foods.
2. **Fermentation Basics**: Introduction to fermentation, raw materials, and processes.
3. **Industrial Applications**: Alcoholic beverages, cheese, bakery products, single cell proteins (SCP), food additives.
4. **Biotechnological Advances**: Genetically modified foods, probiotics, and functional food innovations.

UNIT III: Foodborne Diseases & Intoxications

1. **Microbial Infections & Intoxications**: Bacterial: Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, Listeria. Non-bacterial: nematodes, protozoa, algae, fungi, viruses.
2. **Foodborne Illness Management**: Outbreaks, prevention, and control strategies.
3. **Toxins & Testing**: Aflatoxins: structure, functions, and laboratory testing procedures.
4. **Probiotics & Prebiotics**: Concepts, health benefits, and applications in food safety.

UNIT IV: Food Safety, Hygiene & Quality Assurance

1. **Food Sanitation & Hygiene**: Manufacturing practices, plant sanitation, employee health standards, waste treatment, disposal.
2. **Regulatory Frameworks**: Food control agencies: FDA, EPA, CDC, ISI; Food Safety Act and trade regulations.
3. **Quality Standards & GMP**: Microbiological quality standards, Good Manufacturing Practice (GMP).
4. **HACCP & Preservation Methods**: Hazard Analysis and Critical Control Point system; preservation by high/low temperature, drying, additives, radiation.

Suggested Readings

1. Adams, M.R., and Moss, M.O. Food microbiology. Royal Society of Chemistry Publication, Cambridge.
2. Frazier, W.C. and Westhoff, D.C. Food microbiology. Tata McGraw Hill, New Delhi.
3. Stanbuty, P.F. and Hall, S.J. Principles of fermentation technology. Pergamon Press, Oxford.
4. Banwart, G.J. Basic food microbiology. CBS Publishers and Distributors, New Delhi.
5. Robinson, R.K. Dairy microbiology. Elsevier Applied Sciences, London.
6. James M.J. Modern food microbiology. CBS Publishers and Distributors, New Delhi.
7. Wood, B.J. Microbiology of fermented foods. Elsevier Applied Sciences, London.
8. Ayres, J.C., Mundt, O. and Sandinee, W.E. Microbiology of foods. W.H. Freeman and Company, New York.
9. Jay, M.J., Loessner, M.J. and Golden, D.A. Modern food microbiology. Springer Science and Business Media, New York.
10. Hobbs, B.C. and Roberts, D. Food poisoning and food hygiene. Edward Arnold, London.

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5. AGRICULTURAL BIOTECHNOLOGY

Course Content:

UNIT I: Soil and Microbial Ecology

1. **Soil Components:** Abiotic and biotic factors, Physico-chemical characteristics.
2. **Soil Microbes:** Role of microbial metabolism in soil chemistry and humus formation.
3. **Organic Matter Dynamics:** Decomposition of cellulose, hemicellulose, and lignin.
4. **Decomposition Factors:** Environmental and biological factors influencing organic matter breakdown.

UNIT II: Rhizosphere and Plant-Microbe Interactions

1. **Rhizosphere & Rhizoplane**: Definition, microbial communities, and rhizosphere effect.
2. **Root Exudates:** Composition, factors affecting exudation, and microbial interactions.
3. **Plant Growth Promotion:** PGPR, mycorrhiza, nitrogen fixation, Zinc solubilization, phosphate solubilization, iron chelation.
4. **Microbial Products:** Hormones, antibiotics, and mechanisms of plant growth promotion.

UNIT III: Plant Pathology and Biocontrol

1. **Plant Diseases**: Symptoms, causative organisms, disease cycles (fungal, bacterial, viral).
2. **Major Pathogens:** Fungal, bacterial, and viral diseases of crops (paddy, cotton, potato, tobacco, cauliflower, tomato, sugarcane).
3. **Virulence Mechanisms:** Biochemical and genetic mechanisms of pathogenicity.
4. **Control Measures:** Conventional and modern approaches to disease management.

UNIT IV: Biotechnological Inputs in Agriculture

1. **Biocontrol Agents:** Bacillus thuringiensis, Beauveria bassiana, Metarhizium anisopliae, Trichoderma, Baculoviruses.
2. **Mechanisms of Biocontrol:** Pathogen suppression, viral proteins, antisense RNA, RNAi.
3. **Biofertilizers:** Isolation, purification, mass multiplication, inoculum production, and application methods.
4. **Quality & Marketing:** Storage, shelf life, quality control, and commercialization of biofertilizers.

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Suggested Readings:

1. Alexander, M. *Introduction to Soil Microbiology* – Classic text on soil microbial processes.
2. Subba Rao, N.S. *Soil Microbiology* – Focused on microbial transformations in soil.
3. AgriMoon ICAR eCourse *Agricultural Microbiology* – Covers soil microbes, nutrient cycles, and microbial ecology.
4. Reddy, S.M. & Reddy, S.R. *Microbiology: A Practical Approach* – Includes rhizosphere and PGPR studies.
5. Glick, B.R. *Beneficial Plant-Microbial Interactions* – Detailed mechanisms of PGPR and mycorrhiza.
6. Career Point University *Agricultural Microbiology* – Undergraduate-level introduction to rhizosphere microbiology.
7. Agrios, G.N. *Plant Pathology* – Standard reference for plant diseases, cycles, and control.
8. Singh, R.S. *Introduction to Principles of Plant Pathology* – Undergraduate-friendly overview.
9. Shukla, S.K. et al. *Agricultural Biotechnology (ARS-Pre, NET Syllabus)* – Includes biocontrol and pathogen management.
10. Subba Rao, N.S. *Biofertilizers in Agriculture and Forestry* – Comprehensive guide on biofertilizer production and application.
11. Vessey, J.K. *Plant Growth Promoting Rhizobacteria as Biofertilizers* – Research-based insights.
12. Agrigyan Team *Agricultural Microbiology PDF* – Updated content on biofertilization and microbial genetics.

Dr. Arvind Kumar
(Asst. Professor & Coordinator)

Dr. Alok Sharma
(Asst. Professor)

List of Value-Added Courses (VAC)
based on NEP-2020
For
Undergraduate Courses
(Arts/Science/Commerce/Fine Arts/Social Sciences)

For Semester I & II

Sl. No	Course Title	Credits	Max Marks
1.	Anandam-I	2	50
2.	Digital Enhancement	2	50
3.	Understanding Indian Society & Culture	2	50
4.	National Cadet Corps (NCC)-I (Semester-I)	2	50
5.	National Service Scheme (NSS)-I (Semester-I)	2	50
6.	Nutrition for Health and Fitness	2	50
7.	Geriatric Wellness and Care	2	50
8.	Financial Literacy	2	50
9.	Indian Value System	2	50
10.	Environmental Studies	2	50
11.	National Cadet Corps (NCC)-II (Semester-II)	2	50
12.	National Service Scheme (NSS)-II (Semester-II)	2	50

For course detail please visit www.msbrijuniversity.ac.in

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(Dr. Anok Shu