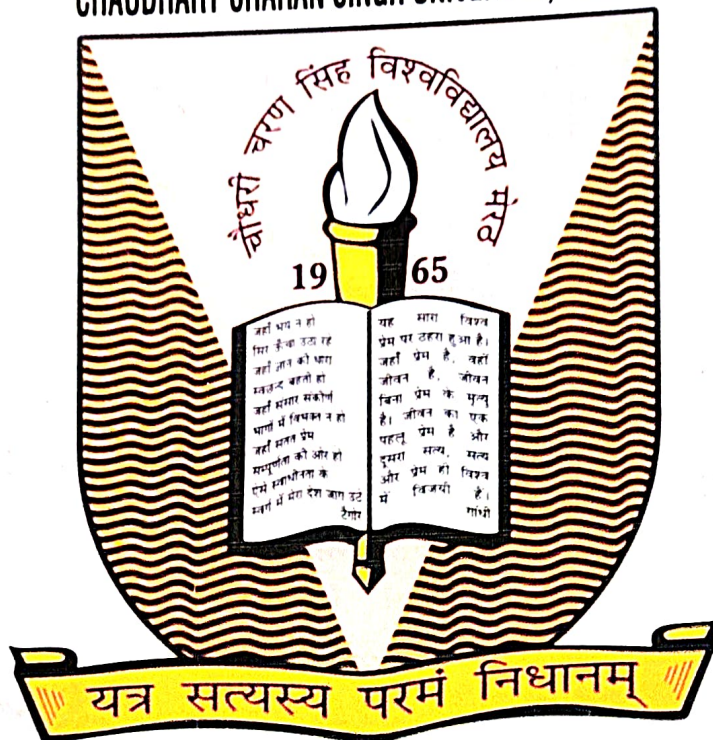




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Chaudhary Charan Singh University, Meerut

CHAUDHARY CHARAN SINGH UNIVERSITY, MEERUT



Program Syllabus
Bachelor of Science in Biotechnology
B.Sc. Biotechnology (Honours/ Honours with Research)
Under New Education Policy (NEP-2020)

Department of Biotechnology

(Effective from Academic Year 2025-26)



चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

CCSU/Biotech./2025/2615-A
Dated: 28.04.2025

Proceedings of the BoS (SFS), Department Biotechnology

1. As per approval of the competent authority (BoS), Department of Biotechnology (SFS) was held in Online mode on 28.04.2025 at 12.00 p.m. to finalize the syllabus and ordinance for **Bachelor of Science (Hons.) Biotechnology 6 Semesters, 3 Years/8 Semesters, 4 Years** w.e.f. session 2025-2026, **M.Sc. Biotechnology 4 Semesters, 2 Years** and list of paper setters/examiners.

Following Members of the Board of Studies were Present:

1.	Prof. Jaimala, Dean, Faculty of Science, Chaudhary Charan Singh University, Meerut-250 004
2.	Prof. Jitender Singh, Coordinator, Biotechnology, Chaudhary Charan Singh University, Meerut- 250 004
3.	Prof. Kashyap Kumar Dubey, Room No. 100 and 110, Kashyap's Lab, School of Biotechnology Jawaharlal Nehru University, New Delhi- 110 067, India, Email: kashyapdubey@mail.jnu.ac.in, Phone: 9996122280
4.	Prof. Meenu Kapoor, Professor and Dean, University School of Biotechnology, AFR-106, University School of Biotechnology, GGS Indraprastha University, Sector 16-C, Dwarka, New Delhi-110 078, Email: meenukapoor@ipu.ac.in, Phone: 011-25302310
5.	Dr. Anil Sirohi, Former Dean, College of Biotechnology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut- 250 110, Phone: 9410275769
6.	Dr. Rajesh Kumar Sharma (Retd. Principal), S.S.V. College, Hapur, Phone: 9411022166
7.	Prof. Vaishali, Professor, College of Biotechnology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut- 250 110, Phone: 9528077774

Following Agenda were discussed and approved:

2. The committee discussed and went through the course contents of **Bachelor of Science (Hons.) Biotechnology 6 Semesters, 3 Years/8 Semesters, 4 Years** and approved the course structure w.e.f. the session 2025-2026 (Annexure "1").
3. The committee discussed and went through the course contents of **M.Sc. Biotechnology 4 Semesters, 2 Years** and approved the course structure for the I and IInd Year course structure w.e.f. the session 2025-2026 (Annexure "2").
4. The Committee also discussed about the Potential Examiners/Experts for the Programme **B.Sc. Biotechnology** (under SFS) at Chaudhary Charan Singh University, Meerut campus as well for affiliated Colleges. The name suggested by the BoS Members were incorporated in the list and same was approved (Annexure "3").

online
Prof. Meenu Kapoor
Subject Expert

online
Prof. Kashyap Kumar Dubey
Subject Expert

[Signature]
Prof. Vaishali
Subject Expert

[Signature]
Dr. Anil Sirohi
Subject Expert

[Signature]
Dr. Rajesh Kumar Sharma
Member

[Signature]
(Prof. Jitender Singh)
Coordinator, Biotechnology
(Invitee)

[Signature]
Dean
Faculty of Science
Chaudhary Charan Singh University
Meerut (UP)-India
28-04-2025



चौधरी चरण सिंह विश्वविद्यालय, मेरठ Chaudhary Charan Singh University, Meerut

Department of Biotechnology

1. Preamble

The role of higher education is very important in securing the lucrative employment and/or providing further access to higher education comparable to the best available in the world class institutions elsewhere. The improvement in the quality of higher education, therefore, deserves to be given highest priority to enable the young generation of students to acquire skill, training and knowledge in order to enhance their thinking, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes in undergraduate programs. The Chaudhary Charan Singh University, Meerut upgraded its undergraduate programme B.Sc. (Hons.) Biotechnology in accordance with model curriculum proposed by UGC and guidelines of NEP 2020 including Outcome Based Education (OBE) and Choice Based Credit System (CBCS), which makes it student-centric, interactive with well-defined aims, objectives and goals. NEP 2020 aims at making higher education multidisciplinary learning process. In other words, the curriculum will be flexible; it will allow students to take up creative subject-combinations.

2. Introduction:

The Biotechnology program at Chaudhary Charan Singh University, Meerut, started in 1996, aims to train students in Biotechnology wherein engineering and technology principles could be used to probe biological questions or to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components. The students in this program acquire knowledge, critical thinking skills and experience in conducting cutting edge research. This program develops human capital for advanced scientific research and entrepreneurship. The syllabus of B.Sc. Biotechnology is designed in such a way that all the courses have their own objectives and methodologies to achieve their respective course outcomes. All the papers combine theoretical inputs with specific practical's related to the needs of various fields of



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Biotechnology teaching and research. To achieve the programme specific outcomes, teachers have to use various direct or indirect methods to achieve overall pedagogical objectives. Due to time limitations in semester system, it is very difficult to achieve all outcomes / targets at the same time. That is why, programme uses different simple and direct measurement tools to assess the extent to which course outcomes have been attained maximum. The new and advanced competency based curriculum emphasizes on the acquisition of competencies as a requisite for progression in the course. The programme adopted advanced and active learning process for the students to develop their skills. The achievement of competencies/pre-determined tasks of students is periodically assessed through internal and summative assessments. A record of activities completed and competencies acquired through each course of the programme is necessarily done to ensure the identification of fast and slow learner and also we recorded that what they gained from the key competencies. The programme periodically encourages student's participation in all the curricular activities organized by different governmental and non-governmental organizations and such activities forms an integral part of the formative/continuous assessment program. To measure course outcomes and attainment level of each student, the department conducts continuous assessment tests, written quizzes, oral quizzes, assignments, small projects, short training, seminar presentations, class discussions, lab practical knowledge in each course and at programme level, 6 month project work with dissertation is compulsory in 4th year for B.Sc. (Hons.) degree with research. The department finds the attainment level of each student on the basis of marks obtained in these tests, quizzes, seminar and assignments. Other co-curricular activities such as field visits, industrial trips, participation in social, environmental and ethics awareness in public domain are also considered for measuring / assessing the attainment of each course outcome and specific program outcome of each student. The targets thus set for the attainment of POs, PSOs and COs are updated every year. From time to time, the university authorities' takes stock of the attainment of programme and course outcomes and suggest corrective measures, which are then implemented by the department.



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3. Vision & Mission

3.1 Vision and Mission of the University

Vision

To produce such professionals who have global competence, vision, and skills as are necessary to meet the challenges of emerging global knowledge economy, by the power of innovation, creativity and efficient learning ability.

Mission

To provide access to quality education and excellence through rigorous efforts of critical thinking, collaborative research, and knowledge creation of global standards in a cooperative ambiance founded on Indian wisdom and values, transforming India into a developed nation.

3.2 Vision and Mission of the Department

Vision

Attaining new heights in biotechnology teaching and research, shaping biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice – especially for the welfare of the farming community.

Department of Biotechnology aspires to become a centre of excellence in Biotechnological research, both nationally and globally, through the pursuit of cutting-edge interdisciplinary research and innovation aimed at understanding and harnessing the power of biotechnological tools to improve human health and achieve a sustainable future.

Mission

Biotechnology is a frontline area of science with immense potential for the benefit of the human kind. The Department shall devote wholly to achieve excellence in the promotion of Plant Biotechnology in the Western Uttar Pradesh. The Department shall provide services in the areas of research, infrastructure, generation of human resource, popularization of biotechnology, promotion of recombinant DNA products and biotechnology-based programs for societal benefits.



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4. Program Educational Objectives (PEOs)

The aim of this program is to prepare students to take up a career in biotechnology industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of biotechnology.

The program has following specific objectives:

PEO1: To teach courses in basic sciences, biotechnology and introduce the concepts of industrial biotechnology.

PEO2: To explain the fundamental and advance concepts of the complexities of life, mechanism of life functions, and diversity of life on the planet.

PEO3: To impart knowledge about biochemical and molecular underpinnings of the cellular and metabolic functions.

PEO4: To impart knowledge about tools and techniques used for the genetic manipulation of bacteria, plants, animals and different life forms or their cellular products.

PEO5: To introduce basic skills required for statistical and biological sequence data analysis.

PEO6: To teach courses highlighting the importance of biotechnology for the society in future.

PEO7: To provide necessary training for conducting basic biotechnology experiments.

Programme Learning Outcome

PL01: Knowledge of basic sciences: Students have the basic knowledge of environmental science, green chemistry, biology and understand its applicability or correlate these science to nature

PL02: Problem analysis: Identify, express, analyze the problems related to natural sciences

PL03: Design/development of solutions: Students will be able to design or generate solutions of common problems of natural science and its output is to improve public and environmental health.

PL04: Modern tool usage: Generate, select, and apply appropriate modern techniques and resources for understanding the concept of natural sciences

PL05: Environment and sustainability: Understand the impact of the science to improve the environmental health and aware about the knowledge and need of sustainable development.



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PL06: Project management and lab culture: Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments

PL07: Future prospective: After the completion of this course students have the option to go for higher studies i.e. M.Sc. and then do some research for the welfare of mankind or prepare for other competitive examinations.

PL08: Life-long and interdisciplinary approach of learning: Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments

Program Specific Outcome (PSO)

The aim of this program is to prepare students to take up a career in biotechnology industry or research. The course curriculum is designed to strengthen the fundamentals in basic subjects and provide hands on practice in all the disciplines of biotechnology.

PSO1: The students will understand the basic metabolic and molecular processes required for normal cellular functions.

PSO2: The students will learn about different tools and techniques required for genetic manipulation, microbial culture and biochemical analysis.

PSO3: The students will be able to execute basic experiments related to biochemistry, microbiology, cell biology, recombinant DNA technology, etc.

PSO4: The students will be able to pursue higher studies in diverse areas of biological sciences or take up jobs in various biotechnology sectors.



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Name of Program: B.Sc. (Hons.) Biotechnology

Eligibility:

Candidates who had passed 12th with 10+2 Biology/ Chemistry/ Computer Science/ PCB/ PCBE/ PCMB/ PCM/ Agriculture/ Mathematics (Minimum 45% marks for Gen./OBC & 40% marks for SC/ST) from a recognized board of examination.

**Program Duration: B.Sc. Biotechnology 6 Semesters, 3 Years/
B.Sc. (Hons.) Biotechnology 8 Semesters, 4 Years**

Number of seats and fee structure initially there should be only 30 seats which may be altered depending upon the facilities available in the Department. Reservation shall apply as per the policy of the University for other Courses on the campus. This course is approved under self-finance scheme of the University/State Govt.

Annual Fee: Rs. 37,500/- (Rs. Thirty Seven thousand Five Hundred only). However, the fee structure may be altered by the University depending upon the resources available.

Program Structure

Curriculum Framework based on National Education Policy-2020

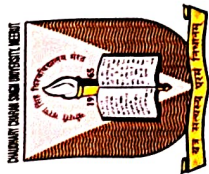
NEP-2020 has conceptualized the idea to develop well rounded competent individuals for making the nation a self-reliant and global leader. In the same spirit, we at Department of Biotechnology have developed a curriculum frame work to encompass the goals of NEP 2020. To this end, we have incorporated choice of subject/ disciplines of study, creating academic pathways having constructive combinations of disciplines for study with multiple entry and exit points as well as focus on **experimental learning** for students by introducing **multidisciplinary and skill enhancement courses** and actual Hands on training in the recent and trending aspects of Biotechnology.

Definition of Credit:

- 1 Hr. Lecture (L) per week 1 Credit
- 1 Hr. Tutorial (T) per week 1 Credit
- 1 Hr. Practical (P) per week 0.5 Credit
- 2 Hrs. Practical (P) per week 1 Credit

B.Sc. (Hons.) Biotechnology

NEP Course Components		*Credits 3 Years	*Credits 4 Years
1	Major Disciplinary Courses (MJDSCC)	72	96
2	Minor Generic Disciplinary Elective Course(MNGEC)	8 or 12or 16	8 or 12or 20
3	Minor Generic Elective Course(MNGEC)	24 or 20 or 16	24 or 20 or 20
4	Ability Enhancement Course (AEC)	8	8
5	Skill Enhancement Course (SEC)	8	12
6	Value Addition Course (VAC)	6	6
7	Dissertation/ Research Project (Hons.) (PROJ)		12
Total		126	166



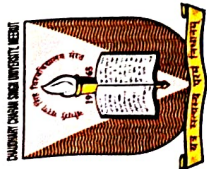
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Chaudhary Charan Singh University, Meerut

Department of Biotechnology

Curriculum for Bachelor of Science Biotechnology; 6 Semesters, 3 Years/ Bachelor of Science (Hons.) Biotechnology 8 Semesters, 4 Years

Year	Semester	Major Discipline Specific Core Course (MJDSCC)				Major Discipline Specific Course (MJDSEC)	Minor Generic Elective Course(MNGEC)(Pool of courses)	Ability Enhancement Course(AEC) (Pool of courses)	Skill Enhancement Course (SEC) (Pool of courses)	Value addition (VAC)	Dissertation/Seminar	Total Credits
Foundation or Introductory Level	I	1. Introductory Biology	3			Introduction to Biotechnology (4)	Basic Communicative English (2)	Bio-techniques-I (2)	Communication Skill & Personality Development (2)		22	
		2. Biological Macromolecules	3									
		3. Cell Biology	3									
		4. Practical based on Paper 1,2,3	3									
	II	1. Evolution and Genetics	3			Biotechnology & Human Welfare (4)	Public Speaking in English Language and Leadership (2)	Bio-techniques-II (2)	Swayam Portal (2)		22	
		2. General Microbiology	3									
		3. Bio-instrumentation	3									
		4. Practical based on Paper 1,2,3	3									
		24			08	04	04	04		44		
*(VIA PCW)	VIAPCW of 4 credits. Note: 1. VIAPCW of 4 credits is mandatory but it may be done in either first or second or third year of Graduation Program. 2. For exit with Certificate VIAPCW of 4 credits after first year is mandatory.											
Total Credits After One Year: 44+4* (mandatory for Certificate)												
Exit-1 and Re-entry: Undergraduate Certificate in Major Discipline after securing 44 credits in two semesters (one year) of a UG (Honours/ Honours with Research) program with single major and in addition 4 credits in a Vocational Course/ Internship/ Apprenticeship/ Project/ Community Outreach/ Workshop (VIAPCW)*. With these credits a student may take re-entry in the second Year.												



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Intermediate Level	III	1. Fundamentals of Biochemistry	3	DSE-1/GE-3 (4) Environmental Biotechnology	AEC-3(2) IPR Protection	SEC-3(2)/IAPC-1(2) Bio-techniques- III (2)	--	20
		2. Plant and Animal Physiology	3					
		3. Molecular Biology	3					
		4. Practical based on Paper 1,2,3	3					
	IV	1. Essentials of Immunology	3	DSE-2/GE-4 (4) Basic Biostatistics	AEC-4(2) Basics of Computer Application	SEC-4(2)/IAPC-2(2) Bio-techniques- IV (2)	Unive rsity Pool Cours e/ Sway am Porta l (2)	22
		2. Recombinant DNA Technology	3					
		3. Plant Biotechnology	3					
		4. Practical based on Paper 1,2,3	3					
	VIAPC W*		24	08	4	4	2	42
		VIAPCW of 4 credits; Note: 1. VIAPCW of 4 credits is mandatory but it may be done in either first or second or third year of Graduation Program.						
2. For exit with Diploma, VIAPCW of 4 credits either after first year or after second year is mandatory.								
		48	16	08	8	06	86	

Total Credits after Two Years : 86+4 (Mandatory for Diploma)

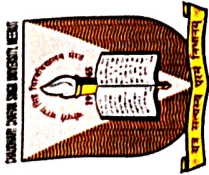
Exit-2 and Re-entry: Undergraduate Diploma in Major Discipline after securing 86 credits in four semesters of a UG (Honours/ Honours with Research) program with single major and in addition 4 credits of Vocational Course/ Internship/ Apprenticeship/ Project/ Community Outreach/ Workshop (VIAPCW)*. With these credits a student may take re-entry in the third Year.

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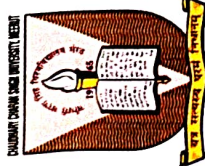


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Higher Level	V	1. Animal Biotechnology	4	DSE-Introduction to Bioinformatics (4)	GE-5 Medical Biotechnology & Diagnostics Tools (4)		20
		2. Nanobiotechnology	4				
		3. Practical based on Paper 1, 2	4				
	VI	1. Basics of Forensic Science	4	DSE-4 Bio-start-ups & Entrepreneurship Development (4)	GE-6 Industrial Biotechnology (4)		20
		2. Gene Editing & NGS	4				
		3. Practical based on Paper 1, 2	4				
		24		08	08		40
VIAPCW*	VIAPCW or a Dissertation based on either of MJDSCC offered during V and VI semesters of 4 credits.; Note: VIAPCW of 4 credits is mandatory if not offered / done in first or second year of Graduation Program						
Total Credits: I Yr. + II Yr. + III Yr.		72		16	16	08	0 126 6
Total Credits after Three Years (UG Degree)							126+4* (Mandatory)
Exit-3: Undergraduate Degree in Major Discipline after securing 126 credits in six semesters of a UG (Honours/ Honours with Research) program with single major and in addition 4 credits of Vocational Course/ Internship/ Apprenticeship/ Project/ Community Outreach/ Workshop (VIAPCW)*. - Requirements for the entry/ re-entry in semester VII for UG (Honours):\$ - Requirements for the entry/ re-entry in semester VII for UG (Honours with Research): #							

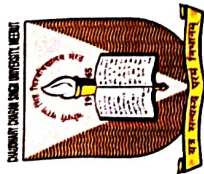
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Fourth		VII	1. Genomics and Proteomics	4	Bioethics and Biosafety (4)	SEC Research Methodology (4)	20							
			2. Pharmaceutical Biotechnology	4										
			3. Practical based on Paper 1, 2	4										
		VIII	1. Food Biotechnology	4	Bioprocess Technology (4)		20							
			2. Agricultural Biotechnology	4										
			3. Practical based on Paper 1, 2	4										
• Student on exit shall be awarded Bachelor of (In the field of Study Discipline) Honours with Research/Academic Projects/ Entrepreneurship)							40							
Total Credits: I Yr+II Yr+ III Yr+ IV Yr							96	12 or 16 or 20	28 or 24 or 20	8	12	6	4	166+4
Total Credits after Four Year (UG Honours) with Single Major														
(Honours) with Single Major Degree on securing a total 170 Credits in eight semester including 4 credits through a VIAPCW														
Exit-4: Four Year Under Graduate (Honours) with Single Major Degree on securing a total 170 Credits in eight semester including 4 credits through a VIAPCW														

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Curriculum for Bachelor of Science Biotechnology; 6 Semesters, 3 Years/
Bachelor of Science (Hons.) Biotechnology; 8 Semesters, 4 Years

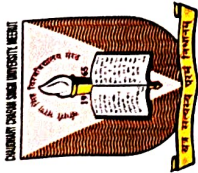
B.Sc Honours with Research with Single Major

VII for UG (Honours with Research)	Advance Level					Research Methodology - Cr: 4	-	-	-	Synopsis of Dissertation Cr.4	20
	1. Genomics and Proteomics	4									
	2. Pharmaceutical Biotechnology	4									
	3. Practical based on Paper 1, 2	4									
VIII for UG (Honours with Research)	1. Food Biotechnology	4	-	-	-	-	-	-	Dissertation Cr: 8	20	
	2. Agricultural Biotechnology	4									
	3. Practical based on Paper 1, 2	4									
Credits VII+VIII (UG Honours with Research)	24					4			12	40	
Total Credits (I Yr+II Yr+III Yr+ IV Yr)	96	8 or 12 or 16	24 or 20 or 16	8		12	6		12	166+4*	
Total Credits after Four Year (UG Honours with Research) with Single Major											166+4*
Exit-4: Four Year Under Graduate (Honours with Research) with Single Major Degree on securing a total 182 credits including 4 credits through a VIAPCW and 12 credits through a Research Dissertation.											

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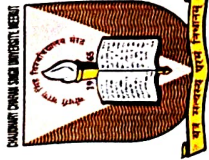
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B.Sc. (Hons.) Biotechnology
Scheme of Teaching and Evaluation
Outcome Based Education (OBE) and Choice Based Credit System (CBCS) as per NEP 2020
(Effective from the academic year 2025-26)

First Year (First Semester)													
I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment		Seminar/ Assignment	External Assessm ent	
									Paper	Quiz			
	1.	MJDSCC	Introductory Biology	3	3				15	5	5	75	100
	2.	MJDSCC	Biological Macromolecules	3	3				15	5	5	75	100
	3.	MJDSCC	Cell Biology	3	3				15	5	5	75	100
	4.	MJDSCC	Practical Based on 1, 2, 3	3			3					100	100
	5.	MNGEC	Introduction to Biotechnology	4	-	-			15	5	5	75	100
	6.	AEC	Basic Communicative English	2					15	5	5	75	100
	7.	SEC	Bio techniques-I	2					40	-	-	60	100
	8.	VAC	Communication Skill & Personality Development	2					-	-	-	100	100
				22								Total	800

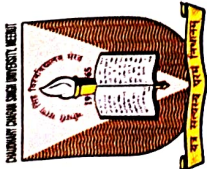
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First Year (Second Semester)													
II	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs.	WEIGHTAGE EVALUATION				Total
									Internal Assessment			External Assessm ent	
									Paper	Quiz	Seminar/ Assignment		
	1.	MJDSCC	Evolution and Genetics	3	3				15	5	5	75	100
	2.	MJDSCC	General Microbiology	3	3				15	5	5	75	100
	3.	MJDSCC	Bio-instrumentation	3	3				15	5	5	75	100
	4.	MJDSCC	Practical Based on 1, 2, 3	3			3					100	100
	5.	MNGEC	Biotechnology & Human Welfare	4					15	5	5	75	100
	6.	AEC	Public Speaking in English Language and Leadership	2					15	5	5	75	100
	7.	SEC	Biotechniques-II	2					40	-	-	60	100
	8	VAC	Swayam Portal course	2					-	-	-	100	100
				22								Total	800

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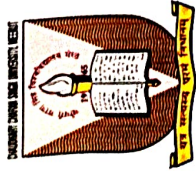


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Second Year (Third Semester)

I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment		External Assessm ent	Paper	
	1.	MJDSCC	Fundamentals of Biochemistry	3	3				15	5	5	75	100
	2.	MJDSCC	Plant and Animal Physiology	3	3				15	5	5	75	100
	3.	MJDSCC	Molecular Biology	3	3				15	5	5	75	100
	4.	MJDSCC	Practical Based on 1, 2, 3	3			3					100	100
	5.	DSE	Environmental Biotechnology	4	-	-			15	5	5	75	100
	6.	AEC	IPR Protection	2					15	5	5	75	100
	7.	SEC	Bio techniques-III	2					40	-	-	60	100
				20								Total	700

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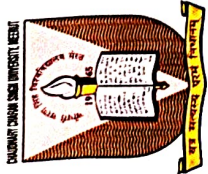


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Second Year (Fourth Semester)

I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment		External Assessment		
									Paper	Quiz	Seminar/ Assignment	Paper	
	1.	MJDSCC	Essentials of Immunology	3	3				15	5	5	75	100
	2.	MJDSCC	Recombinant DNA Technology	3	3				15	5	5	75	100
	3.	MJDSCC	Plant Biotechnology	3	3				15	5	5	75	100
	4.	MJDSCC	Practical Based on 1, 2, 3	3			3					100	100
	5.	DSE	Basic Biostatistics	4					15	5	5	75	100
	6.	AEC	Basics of Computer Application	2					15	5	5	75	100
	7.	SEC	Biotechniques-IV	2					40	-	-	60	100
	8	VAC	University Pool Course/ Swayam Portal course	2					-	-	-	100	100
				22								Total	800

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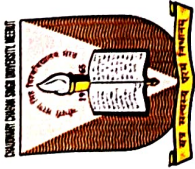


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Third Year (Fifth Semester)

I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment			External Assessment	
									Paper	Quiz	Seminar/Assignment		
	1.	MJDSCC	Animal Biotechnology	4	4				15	5	5	75	100
	2.	MJDSCC	Nano biotechnology	4	4				15	5	5	75	100
	3.	MJDSCC	Practical Based on 1, 2, 3	4			4					100	100
	4.	MJDSEC	Introduction to Bioinformatics	4	-	-			15	5	5	75	100
	5.	MNGE	Medical Biotechnology & Diagnostics Tools	4					15	5	5	75	100
				20								Total	500

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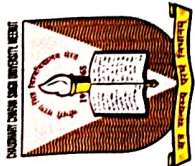


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Third Year (Sixth Semester)

I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment		External Assessment		
									Paper	Quiz	Seminar/Assignment	Paper	
1.	MJDSCC		Basics of Forensic Science	4	4				15	5	5	75	100
2.	MJDSCC		Gene Editing & NGS	4	4				15	5	5	75	100
3.	MJDSCC		Practical Based on 1, 2, 3	4			4					100	100
4.	MJDSEC		Bio-startups & Entrepreneurship Development	4					15	5	5	75	100
5.	MNGE		Industrial Biotechnology	4					15	5	5	75	100
				20								Total	500

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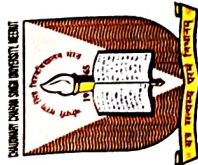


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Fourth Year (Seventh Semester)

I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total
									Internal Assessment		External Assessment		
									Paper	Quiz	Seminar/ Assignment	Paper	
	1.	MJDSCC	Genomics and Proteomics	4					15	5	5	75	100
	2.	MJDSCC	Pharmaceutical Biotechnology	4					15	5	5	75	100
	3.	MJDSCC	Practical Based on 1, 2	4			4					100	100
	4.	MNGE(Pool of courses)	Bioethics and Biosafety	4					15	5	5	75	100
	5.	SEC	Research Methodology	4					40	-	-	60	100
				20								Total	500

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Fourth Year (Eight Semester)														
I	S. No.	Components of the course	Title	Credits	L	T	P	Credits hrs	WEIGHTAGE EVALUATION				Total	
									Internal Assessment		Seminar/ Assignment	External Assessment		
									Paper	Quiz		Paper		Assessm ent
	1.	MJDSCC	Food Biotechnology	4	4				15	5	5	75	100	
	2.	MJDSCC	Agricultural Biotechnology	4	4				15	5	5	75	100	
	3.	MJDSCC	Practical Based on 1, 2	4			4					100	100	
	4.	MJDSEC	Bioprocess Technology	4	4				15	5	5	75	100	
	5.	MJDSCC	Seminar	4	4								100	
				20								Total	500	

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 1	
Introductory Biology	SDG 3: Good Health and Well-being SDG 4: Quality Education
Biological Macromolecules	SDG 3: Good Health and Well-being SDG 4: Quality Education
Cell Biology	SDG 3: Good Health and Well-being SDG 4: Quality Education
Practical Based on 1, 2, 3	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Introduction to Biotechnology	SDG 3: Good Health and Well-being SDG 13: Climate Action
Basic Communicative English	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth
Biotechniques- I	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Communication Skill & Personality Development	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 1	
Introductory Biology	Skill development
Biological Macromolecules	Skill development
Cell Biology	Skill development
Practical Based on 1, 2, 3	Skill development/ Employability
Introduction to Biotechnology	Skill development
Basic Communicative English	Employability
Biotechniques- I	Skill development/ Employability
Communication Skill & Personality Development	Employability

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Chaudhary Charan Singh University, Meerut

Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 2	
Evolution and Genetics	SDG 3: Good Health and Well-being SDG 4: Quality Education
General Microbiology	SDG 3: Good Health and Well-being SDG 6: Clean Water and Sanitation
Bio-instrumentation	SDG 3: Good Health and Well-being SDG 4: Quality Education
Practical Based on 1, 2, 3	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Biotechnology & Human Welfare	SDG 3: Good Health and Well-being SDG 13: Climate Action
Public Speaking in English Language and Leadership	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth
Biotechniques- II	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Swayam Portal course	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 2	
Evolution and Genetics	Skill development
General Microbiology	Skill development
Bio-instrumentation	Skill development
Practical Based on 1, 2, 3	Skill development/ Employability
Biotechnology & Human Welfare	Skill development
Public Speaking in English Language and Leadership	Employability
Biotechniques- II	Skill development/ Employability
Swayam Portal course	Skill development/ Employability

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
	Semester 3
Fundamentals of Biochemistry	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Plant and Animal Physiology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Molecular Biology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Practical Based on 1, 2, 3	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Environmental Biotechnology	SDG 3: Good Health and Well-being SDG 13: Climate Action
IPR Protection	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth
Biotechniques- III	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
	Semester 3
Fundamentals of Biochemistry	Skill development
Plant and Animal Physiology	Skill development
Molecular Biology	Skill development
Practical Based on 1, 2, 3	Skill development/ Employability
Environmental Biotechnology	Employability/ Entrepreneurship
IPR Protection	Employability/ Entrepreneurship
Biotechniques- III	Skill development/ Employability

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 4	
Essentials of Immunology	SDG 3: Good Health and Well-being SDG 13: Climate Action
Recombinant DNA Technology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Plant Biotechnology	SDG 3: Good Health and Well-being SDG 13: Climate Action
Practical Based on 1, 2, 3	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Basic Biostatistics	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Basics of Computer Application	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth
Biotechniques-IV	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
University Pool Course/ Swayam Portal course	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 4	
Essentials of Immunology	Skill development
Recombinant DNA Technology	Skill development
Plant Biotechnology	Skill development
Practical Based on 1, 2, 3	Skill development/ Employability
Basic Biostatistics	Employability/ Entrepreneurship
Basics of Computer Application	Employability/ Entrepreneurship
Biotechniques-IV	Skill development/ Employability
University Pool Course/ Swayam Portal course	Skill development/ Employability

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 5	
Animal Biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Nano biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Practical Based on 1, 2, 3	SDG 3: Good Health and Well-being SDG 4: Quality Education
Introduction to Bioinformatics	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Medical Biotechnology & Diagnostics Tools	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 5	
Animal Biotechnology	Skill development
Nano biotechnology	Employability/ Entrepreneurship
Practical Based on 1, 2, 3	Skill development/ Employability
Introduction to Bioinformatics	Employability/ Entrepreneurship
Medical Biotechnology & Diagnostics Tools	Employability/ Entrepreneurship

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Chaudhary Charan Singh University, Meerut

Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 6	
Basics of Forensic Science	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Gene Editing & NGS	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Practical Based on 1, 2, 3	SDG 3: Good Health and Well-being SDG 4: Quality Education
Bio-start-ups & Entrepreneurship Development	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Industrial Biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 6	
Basics of Forensic Science	Employability/ Entrepreneurship
Gene Editing & NGS	Employability/ Entrepreneurship
Practical Based on 1, 2, 3	Skill development/ Employability
Bio-start-ups & Entrepreneurship Development	Employability/ Entrepreneurship
Industrial Biotechnology	Employability/ Entrepreneurship

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 7	
Genomics and Proteomics	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Pharmaceutical Biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Practical Based on 1, 2	SDG 3: Good Health and Well-being SDG 4: Quality Education
Bioethics and Biosafety	SDG 3: Good Health and Well-being SDG 4: Quality Education
Research Methodology	SDG 3: Good Health and Well-being SDG 4: Quality Education

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 7	
Genomics and Proteomics	Skill development/ Employability
Pharmaceutical Biotechnology	Employability/ Entrepreneurship
Practical Based on 1, 2	Skill development/ Employability
Bioethics and Biosafety	Employability/ Entrepreneurship
Research Methodology	Skill development/ Employability

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Mapping of Courses to Sustainable Development Goals (SDGs)

Course	Mapped SDGs
Semester 8	
Food Biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Agricultural Biotechnology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Practical Based on 1, 2	SDG 3: Good Health and Well-being SDG 4: Quality Education
Bioprocess Technology	SDG 3: Good Health and Well-being SDG 9: Industry, Innovation and Infrastructure
Seminar	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure
Dissertation	SDG 4: Quality Education SDG 9: Industry, Innovation and Infrastructure

Mapping of courses to employability/ entrepreneurship/ skill development

Course	Employability/ Entrepreneurship/ Skill development
Semester 8	
Food Biotechnology	Employability/ Entrepreneurship
Agricultural Biotechnology	Employability/ Entrepreneurship
Practical Based on 1, 2	Skill development/ Employability
Bioprocess Technology	Employability
Seminar	Skill development
Dissertation	Employability/ Entrepreneurship

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Chaudhary Charan Singh University, Meerut

Semester-I

Course Name: INTRODUCTORY BIOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand historical account and organism's classification. CO2: Evolutionary history of living organisms. CO3: Learn about diversity of living organisms. CO4: Characterization of living organisms. CO5: Classification of living organisms.		
Unit 1 What is living? Analysing the living things. Taxonomy and Systematics, Basics in classification, Rules of biological nomenclature, Taxonomical Hierarchy, Concept of species, Systems of biological classification.		
Unit 2 Palaeontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.		
Unit 3 Emergence of evolutionary thoughts Lamarck; Darwin-concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.		
Unit 4 Archegoniate, Bryophytes and Pteridophytes- An introduction, general characters, classification and economic importance. Gymnosperms and Angiosperms- An introduction, general characters, classification and economic importance.		
Unit 5 Non-chordates- An introduction, General characteristics and classification. Chordates: An introduction, General characteristics and Classification.		
Suggested Readings (Latest Editions): 1. Richard Fox, Robert D. Barnes, Edward E. Ruppert, Invertebrate Zoology: A Functional Evolutionary Approach, Brooks/Cole; 7th edition edition2003. 2. Hyman, L.H. Invertebrate Series (Recent edition). 3. Kotpal RL; Modern Textbook of Zoology -Vertebrates; Rastogi Publications - Meerut; 2016 edition 4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc. 5. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons. 6. Satyanarayan and Chakrapani, (2017) Biochemistry, Elsevier; Fifth edition 7. Verma PS and Agrawal VK, Chordata Embryology (2010) (S Chand Publication). 8. Puri, P. (1985). Bryophytes. Atmaram & Sons, Delhi, Lucknow. 9. Gilbert, M.S. (1985). Cryptogamic Botany, Vol. I&II (2 nd Ed.), Tata McGraw Hill Publishing Co. Ltd. New Delhi. 10. Gifford, E.M. & Foster, A.S. (1989). Morphology and evolution of Vascular Plants. W.H. Freeman & Co., New York, USA. 11. Reven, P.H., Evert, R.F. & Eichhorn, S.E. (1999). Biology of Plants (5 th Ed.), W.H. Freeman & Co., New York, USA. 12. Sporne, K.R. (1991). The Morphology of Gymnosperms, B.I. Publications Pvt. Bombay, Calcutta, Delhi. 13. Wilson, N.C. & Rothwell, G.W. (1996). Palaeobotany and the Evolution of Plants (2 nd Ed.), Cambridge University Press, UK.		



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Course Name: BIOLOGICAL MACROMOLECULES	Credits: 03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Basic structure and importance of carbohydrates. CO2: Basic structure and importance of proteins. CO3: Basic structure and importance of enzymes. CO4: Basic structure and importance of lipids. CO5: Basic structure and importance of vitamins and hormones.		
Unit 1 Carbohydrates: Definition and Properties of Carbohydrates; Structure and function of mono, Di and Polysaccharides (Glucose, Mannose, Fructose, Galactose, Lactose, Sucrose, Glycogen, Starch and Cellulose); Isomerism of Carbohydrates; Mutarotation; Glycoproteins, Peptidoglycans, Lipopolysaccharides.		
Unit 2 Amino acids & Proteins: Amino acids: Structure and classification. Non-protein Amino Acids, Physical and Chemical Properties of Amino Acids, Peptide bond, Primary structure, Secondary structure, & Ramachandran Plot, Tertiary Structure of Proteins, Forces stabilizing Protein Structure.		
Unit 3 Enzymes: Definition, Classification & nomenclature of enzymes -Specificity of enzyme action - Fischer's Lock and Key Hypothesis & Koshland's Induced Fit Hypothesis - Active site - coenzyme, enzyme inhibitors, Regulatory enzymes,. Biological importance of enzymes (ribonuclease and chymotrypsin)		
Unit 4 Lipids: Classification of Lipids and Fatty Acids; Structure and Function of Saturated and Unsaturated Fatty Acids, Triglycerides and Cholesterol; Structure & function of Phospholipids, Sphingolipids, Cerbrosides.		
Unit 5 Vitamins: Vitamins: Structure and function of water soluble (B1, B2, B6, B12, C) & lipid soluble (A, D, E, K). Hormones: properties and function of Peptide hormones, Steroid hormones & Amino-acid derivatives, Structure of Purines, Pyrimidines, Nucleosides and Nucleotides; Structure of "Biologically important Nucleotides and their function (FADH, NADH, NADPH, Co-A).		
Suggested Readings (Latest Editions): 1. Nelson, D.L., Cox, M.M. (2013). Lehninger: Principles of Biochemistry. 6th Edition. W.H. Freeman and Company Devlin. 2. T.M. (2011). Textbook of Biochemistry with Clinical Correlations. 7th Edition. John Wiley & Sons, Inc. 3. Berg, J.M., Tymoczko, J.L., Stryer, L. (2012). Biochemistry. 7th Edition. W.H. Freeman and Company.		

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Chaudhary Charan Singh University, Meerut

Course Name: CELL BIOLOGY

Credits:03

Course No:

Course Outcome (CO): Upon successful completion of this course the student will:

- CO1: Understand Macromolecules in cells.
- CO2: Learn about Cell Membrane and Permeability.
- CO3: Explain Extracellular Matrix of cell.
- CO4: Describe Transport Across Cell Membranes.
- CO5: Know about Microscopy and advances.

Unit 1

Macromolecules in cells: Introduction to – Proteins and different components involved in protein synthesis, Nucleic acids, concept of gene and packing of DNA into chromosomes, carbohydrates, Phospholipids. Cell: Historical development in cell biology, Introduction and classification of organisms by cell structure, prokaryotic (bacteria, their structure and energy generation process) and eukaryotic cells (animal & plant cells)

Unit 2

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, Organelles of plant and animal cell: Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes, Nucleus: Structure and function, chromosomes and their structure, plastids, Vacuoles.

Unit 3

Introduction to extracellular Matrix of cell, Cell-Cell and Cell-Basal membrane adhesion, Receptors of cell – cell membrane receptors and types, cytosolic and nuclear receptors, regulation of receptor expression and function. Signal transduction by receptors and introduction of basic signalling mechanisms (GPCR, RTK, Gas signalling, cytosolic and nuclear receptors). Cell division, different phases of mitosis, meiosis and their molecular mechanism.

Unit 4

Transport Across Cell Membranes: Passive & active transport, permeases, sodium potassium, Ca²⁺ ATPase pumps, lysosomal and vacuolar membrane, ATP dependent proton pumps, co transport symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis, entry of viruses and toxins into cells.

Unit 5

Microscopy and advances: Introduction to different microscopes and basics about functioning. Introduction to Development of cancer, causes, types, Diagnosis and therapy. Programmed cell death. Introduction of Stem cells. Types: Embryonic stem cell, induced pluripotent stem cells.

Suggested Readings (Latest Editions):

1. David P Clark, Cell and Molecular Biology.
2. J.E. Krebs, Lewin's Genes X, Jones Pub.
3. T.A. Brown, Gene cloning of DNA Analysis. Wiley Blackwell.
4. J D Watson, Molecular biology.
5. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, Becker's Word of the cell.
6. Gerald Karp, Cell Biology, Wiley Blackwell, Pub.
7. E.D.P. De Robertis and E.M.F. De Robertis, Jr. 2012 Cell and Molecular Biology (Eighth edition). B.I. Waverly Pvt. Ltd. New Delhi.
7. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell, 2009. Molecular Cell Biology (Fourth Edition). Media Connected-W.H. Freeman and Company.
8. P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S. Chand & Company Ltd., New Delhi.
9. B., Alberts, 2009 Essential Cell Biology (Third Edition), Garland Science; publishers

Practical based on Paper 1, 2, 3



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Chaudhary Charan Singh University, Meerut

Course Name: INTRODUCTION TO BIOTECHNOLOGY	Credits: 03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will:		
CO1: Basic principles of enzymes used in genetic engineering.		
CO2: Understand the various methods of molecular cloning.		
CO3: Understand the cloning vectors.		
CO4: Basic concepts of gene transfer techniques and polymerase chain reaction.		
Unit 1 What is Biotechnology? Historical inputs. Biotechnology as a 'tool' not a 'product', Interdisciplinary nature. Foundation of Biotechnology: Importance of basic Biology disciplines eg. Human, Animal and Plant Physiology, Genetics, Cell and Molecular Biology, Microbiology, Biochemistry, Immunology and Chemical engineering.		
Unit 2 Enzymes and Molecular Cloning: Restriction endonuclease, DNA ligases, polynucleotide kinase, klenow enzyme, DNA Polymerase- I, reverse transcriptase, alkaline phosphatase, terminal nucleotidyl transferase		
Unit 3 Cloning Vectors: PBR 322, Bacteriophage, Cosmid, Phagemid, Shuttle vectors, Gene Transfer Techniques: Physical, Chemical and Biological methods		
Unit 4 Polymerase Chain Reaction: PCR reaction, types and its applications		
Unit 5 Applications of Recombinant DNA Technology: Agriculture, Medicine, Genetically modified animals and crops, transgenic products (insulin)		
Suggested Readings (Latest Editions): 1. Brown, TA 2010. Gene Cloning and DNA Analysis, 6th ed. Wiley-Blackwell. 2. Rastogi, S and Pathak, N 2009. Genetic Engineering, 1st ed. Oxford University Press. 3. Winnacker, EL 1987. From Genes to Clones: Introduction to Gene Technology, Wiley-VCH. 4. Dubey, RC 2010. A Textbook of Biotechnology. S Chand Publications. 5. Singh, BD 2013. Expanding Horizons in Biotechnology. Kalyani Publication. 6. Old, RW and Primrose, SB 2006. Principles of Gene Manipulation: An Introduction to Genetic Engineering, 7th ed. Blackwell Science Inc. 7. Chaudhuri, K 2013. Recombinant DNA Technology, TERI Press, New Delhi.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Credits:		Course No:
Course Name: BIOTECHNIQUES - I		
Course Outcome (CO): Upon successful completion of this course the student will:		
CO1: Understand basics of Microscopy.		
CO2: Learn about staining techniques.		
CO3: Learn about different cell biology techniques.		
CO4: Learn about different microbial techniques.		
CO5: Learn about museum and herbarium.		
List of Practical's		
1. Study of light microscopy.		
2. Preparation and observation of plant and microbial slides.		
3. Observation of animal slides.		
4. Measurement of cell using ocular micrometer and stage micrometer		
5. Staining techniques.		
6. Preparation of permanent slides for different materials.		
7. Mitosis in onion root tip.		
8. Plasmolysis in onion.		
9. Cell counting method- animal cell (Haemocytometer) plant cells- stomatal density		
10. Perform cleaning and sterilization techniques.		
11. Study the working principle of pH Meter, LAF, Centrifuge, Autoclave, Spectrophotometer etc.		
12. Preparation of Solid, Liquid, and Semi-Solid Media.		
13. Techniques for Inoculation and enumeration of microbes.		
14. Isolation and characterization of microbes.		
15. Maintenance of Pure Cultures.		
16. Bacterial Motility Assay.		
17. Gram Staining Procedure		
18. Microbial Growth Curve Analysis		
19. Study of museum animals.		
20. Preparation techniques of herbarium.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ Chaudhary Charan Singh University, Meerut

Semester-II

Course Name: EVOLUTION AND GENETICS	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the origin of life. CO2: Learn about basic genetics. CO3: Learn about Mendelian genetics. CO4: Understand linkage and cross over. CO5: Understand epigenetics.		
Unit 1 Theories of the origin of life, evidence for the theory of evolution, palaeontology, comparative anatomy, embryology and biochemistry. Adaptive radiation, modern views on evolution. Evolution of Human (<i>Homo sapiens</i>).		
Unit 2 Mechanism of speciation, population genetics, gene pool, allele frequency, genotype frequency, genetic polymorphism, Hardy-Weinberg equation.		
Unit 3 Mendelian genetics, monohybrid and dihybrid crosses, test cross, back cross, reciprocal cross, chromosomal basis of inheritance, allele, multiple alleles, pseudoalleles, Epistasis, Hypostasis, Co-dominance, Incomplete dominance.		
Unit 4 Linkage and crossing over, recombination, sex determination, sex linked Inheritance (autosomal and allosomal), blood groups, lethal genes, mutation and variations. Structural organization of chromosomes, packaging of DNA molecules into chromosomes, Giant chromosomes, polytene chromosomes, Chromosomal aberrations.		
Unit 5 Epigenetics- DNA methylation and histone modification (Acetylation, Methylation and Phosphorylation). Non coding RNA and prion proteins.		
Suggested Readings (Latest Editions): 1. D.J. Taylor, N.P.O. Green, G.W. Stout, Edited by R. Soper. Biological Science (3rd edition) – Cambridge university press. 2008. 2. Ridley, M. Evolution (3rd edition). Blackwell publishers. 2004. 3. Chapman, J.L & Reiss, M. J. Ecology (3rd edition). Cambridge University Press. 2008. 4. Raven, Johnson, Mason, Losos & Singer. Biology (9th edition). Tata McGraw Hill Education, New Delhi. 2011. 5. Brooker, R.J. Genetics: Analysis & Principles (4th edition). Tata McGraw Hill Education. 2011. 6. Gardner EJ, Simmons MJ, Snustad DP. Principles of Genetics. 8th Ed. Wiley- India. 2008. 7. Snustad DP, Simmons MJ. Principles of Genetics. 6th Ed. John Wiley and Sons Inc. 2011. 8. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. Introduction to Genetic analysis, 9th Ed. W.H. Freeman and Co., NewYork. 2007.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
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Course Name: GENERAL MICROBIOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will:		
CO1: Understand historical account and microbial classification.		
CO2: Learn about microbial diversity.		
CO3: Explain Microbial nutrition and cultivation.		
CO4: Describe sterilization techniques.		
CO5: Know microbial growth pattern and kinetics.		
Unit 1 History and Evolution of Microbiology, Koch's postulates, classification of microorganisms: Microbial taxonomy, criteria used to include molecular approaches, Microbial phylogeny, and current classification of bacteria.		
Unit 2 Microbial Diversity: Distribution and characterization, morphology and cell structure of major groups of microorganisms e.g. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.		
Unit 3 Microbial nutrition and cultivation: Cultivation and Maintenance of microorganisms, Nutritional categories of micro-organisms, Culture media, methods of isolation, purification and preservation.		
Unit 4 Sterilization techniques: Physical means of sterilization (Temperature, osmotic pressure, radiation, filtration), chemical means of sterilization (halogens, heavy metals and their derivatives, alcohols, aldehydes, detergents and Gases).		
Unit 5 Microbial growth: Growth curve, generation time, synchronous and di-auxic growth, batch and continuous culture, measurement of growth and factors affecting growth of bacteria.		
Suggested Readings (Latest Editions): 1-Wiley JM, Sandman KM, and Wood, DH (2018) Prescott's Microbiology 11th edition, McGraw Hill Education, USA, ISBN 978-1-260-21188-7 2-Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley (Brock Biology of Microorganisms) 16th edition Pearson Education, UK 2022 3- Gerard J. Tortora, Berdell R. Funke, Christine L. Case "Microbiology: An Introduction" 14th edition Pearson Education, UK 2023. 4- Jacquelyn G. Black, Laura J. Black Microbiology: Principles and Explorations 10th edition John Wiley & Sons, Inc., USA 2023 5. Cappuccino JH, and Sherman N, (2017) Microbiology: A Laboratory Manual. 11th ed., Pearson Education Inc, ISBN: 9780134298597 6- Kathleen Park Talaro, Barry Chess "Foundations in Microbiology" 11th edition McGraw-Hill Education, USA 2023		

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Chaudhary Charan Singh University, Meerut

Course Name: BIO-INSTRUMENTATION	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand Basic principle and functioning of industrial fermenter. CO2: Learn about Basic principles and functioning of LAF. CO3: Explain Basic principles and applications of-Visible Spectrophotometer. CO4: Describe Basic principles of Chromatography. CO5: Describe Principles and applications of Electrophoresis.		
Unit 1 Basic principle and functioning of industrial fermenter scope, relevance and future of microbial biotechnology to mankind.		
Unit 2 Basic principles and functioning of LAF (Laminar Air Flow), Autoclave, Hot air Oven, BOD incubators		
Unit 3 Basic principles and applications of-Visible Spectrophotometer, pH meter, Flame photometer, Atomic Absorption Spectrophotometer, Oven, melting point apparatus,		
Unit 4 Chromatography (paper, thin layer, column, gel filtration, ion exchange, and affinity chromatography), HPLC, FPLC, basic principle and functioning of GC/LC/MS instrument.		
Unit 5 Principles and applications of Electrophoresis for Proteins and DNA; Iso-electric focusing and 2-D gel electrophoresis; Autoradiography, X-Ray diffraction; PCR, DNA probes, Centrifugation; Ultra-centrifugation, Ultrafiltration, Lyophilization.		
Suggested Readings (Latest Editions) 1. Nelson D and Cox MM, Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York. 2. Wilson K. and Walker J, Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press. 3. Voet and Voet, Principles of Biochemistry. 4. Willey J, Sherwood L. and Woolverton C., Prescott's Microbiology, McGraw Hill. 5. Upadhyaya and Nath, Biophysical chemistry, Himalaya pub. House. 6. Wilson, K and Walker, J 2000. Principles and Techniques of Practical Biochemistry, 5th ed. Cambridge university press. 7. Skoog, DA and West, DM 1982. Fundamentals of Analytical Biochemistry, 4th ed. Saunders College Publishing. 8. Günzler, H and Williams, A 2001. Handbook of Analytical Techniques, 1st ed. Wiley-VCH. 9. Wilson, K 2010. Principles And Techniques of Biochemistry and Molecular Biology, 7th ed. Cambridge University Press.		

Practical based on Paper 1, 2, 3

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIOTECHNOLOGY AND HUMAN WELFARE	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Recognize the importance of various molecular techniques used in biotechnological industry and modern agriculture. CO2: Understand the importance of biotechnology in relation to environment and pollution. CO3: Learn about various applications-based techniques in biotechnology like forensic science in relation to crime. CO4: Comprehend the application of biotechnology in therapeutic drug and vaccine development, gene therapy and diagnostics.		
Unit 1 Protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.		
Unit 2 N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.		
Unit 3 Chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.		
Unit 4 Solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.		
Unit 5 Development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in <i>E. coli</i> , human genome project.		
Suggested Readings (Latest Editions): 1. Sateesh, MK 2010. Bioethics and Biosafety. IK International Pvt Ltd. 2. Dubey, RC 2010. A Textbook of Biotechnology. S Chand Publications. 3. Singh, BD 2013. Expanding Horizons in Biotechnology. Kalyani Publication. 4. Sree Krishna, V 2007. Bioethics and Biosafety in Biotechnology. New age international publishers.		

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Chaudhary Charan Singh University, Meerut

Course Name: BIOTECHNIQUES - II	Credits:	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand basics of Micropropagation. CO2: Learn about biochemical estimation of plant samples. CO3: Learn about biochemical estimation of animal samples. CO4: Learn about estimation of protein samples.		
List of Practical's 1. Maintenance and sterilization of plant tissue culture lab. 2. Preparation of plant tissue culture media. 3. Explant selection and sterilization. 4. Callus induction. 5. Carbohydrate Estimation using Anthrone Method. 6. Qualitative Analysis of Carbohydrates. 7. Amino Acid estimation using Ninhydrin Method. 8. Extraction and Characterization of Starch. 9. Estimation of total Cholesterol. 10. Determination of Bile Salts in Urine. 11. Measurement of Albumin Levels in Urine. 12. Analysis of Unsaturated Fatty Acids. 13. Assay for Salivary Amylase Activity. 14. Isoelectric precipitation of proteins. 15. Precipitation of Immunoglobulin from serum. 16. Separation of Amino acids by chromatography. 17. Total Protein Estimation with Biuret Method. 18. Total Protein Estimation with Bradford Method. 19. Total Protein Estimation with Lowry Method. 20. Crude DNA extraction.		

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Chaudhary Charan Singh University, Meerut

Course Name: ANIMAL BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Comprehend the fundamental concepts of animal cell culture and its applications. CO2: Understand the significance of transgenes is with reference to animals. CO3: Remember the stem cells and their various applications CO4: Learn the fundamentals of gene therapy and its applications.		
Unit 1 Animal cell culture: Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; culture types: suspension, continuous flow and immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.		
Unit 2 Gene transfer methods in animals: Microinjection, embryonic stem cell, gene transfer, retroviral gene transfer, integration of foreign genes and their validation; gene targeting; methods and strategies; improving transgene integration efficiency.		
Unit 3 Assisted reproductive technologies: Artificial insemination; cryopreservation of semen and embryos; multiple ovulation, <i>in-vitro</i> fertilization and embryo transfer techniques, nuclear transfer and cloning.		
Unit 4 Stem cell and its applications: Stem cells: types and sources; characteristics of stem cells, potency and plasticity of stem cells; stem cell markers; induced pluripotent stem cells; applications of stem cells in disease cure.		
Unit 5 Transgenic animals and gene therapy: Strategies for the production of transgenic animals; applications of transgenic animals; gene therapy, types of gene therapy; vectors in gene therapy; human gene therapy.		
Suggested Readings (Latest Editions): 1. Pinkert, C 2014. Transgenic Animal Technology, 3rd ed. Elsevier 2. Ranga, M 2010. Animal Biotechnology, 3rd ed. Agrobios. 3. Verma, A and Singh, A 2013. Animal Biotechnology: Models in Discovery and Translation, 1 st ed. Academic press.		

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Chaudhary Charan Singh University, Meerut

Course Name: NANOBIO TECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Learn history, properties, synthesis, and characterization of nanomaterials. CO2: Study various uses of nanotechnology in electronics, energy, environment, and medicine. CO3: Understand the intersection of nanotechnology and biotechnology. CO4: Assess societal, ethical, safety, and regulatory aspects of nanotechnology. CO5: Explore emerging trends and future prospects in nanotechnology research and applications.		
Unit 1 Introduction to Nanotechnology: Definition and Historical milestones. Scale and Size: Understanding nanometres and their significance, Comparison with other scales (macro, micro). Nanostructures in Biological Systems: Proteins, DNA and Biomimetic nanostructures.		
Unit 2 Properties and Synthesis of Nanomaterials: Physical properties, Chemical properties, Mechanical properties, Optical properties, Quantum effects. Synthesis of Nanomaterials: Top down and bottom-up approaches. Common synthesis methods: Sol-gel, chemical vapor deposition.		
Unit 3 Characterization Techniques: Microscopy: Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Spectroscopy: UV Vis Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy. Xray Techniques: Xray diffraction (XRD).		
Unit 4 Applications of Nanotechnology: Electronics: Nanotransistors, Quantum dots, Nanosensors. Energy: Solar cells, Fuel cells, Batteries. Environment: Water purification, Air filtration, Environmental sensors. Medicine: Drug delivery systems, Diagnostic tools, medical imaging. cancer therapy, Biosensors for biomolecules and pathogens detection.		
Unit 5 Nano biotechnology and Ethical Aspects: Nanobiotechnology Techniques Bioconjugation, Nanoparticle synthesis using biological methods, Safety Concerns: Toxicity of nanomaterials, Environmental and health impacts, Regulatory Frameworks: Guidelines and Policies for safe use and disposal of nanomaterials. Future prospects in nanotechnology and nanobiotechnology.		
Suggested Readings (Latest Editions): 1. Poole Jr., C. P., & Owens, F. J. (2003). Introduction to Nanotechnology. John Wiley & Sons. 2. Kulkarni, S. K. (2019). Nanotechnology: Principles and Practices. CRC Press. 3. Niemeyer, C. M., & Mirkin, C. A. (2004). Nano biotechnology: Concepts, Applications and Perspectives. Wiley-VCH. 4. Hunt, G., & Mehta, M. (2018). Nanotechnology: Risk, Ethics and Law. Earthscan. 5. Feynman, R. P. (2012). There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics. Basic Books. 6. Kumar, C. S. S. R. (2017). Nanomaterials for Medical Diagnosis and Therapy. Wiley. 7. Rao, C. N. R., & Müller, A. (Eds.). (2007). Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience. Wiley-VCH. 8. Andrews, D. L., & Scholes, G. D. (Eds.). (2014). Excitons in Nanoscale Systems. Springer. 9. Bharat, B. (2015). Nanotechnology Applications for Clean Water. William Andrew. 10. Sozer, N., & Kokini, J. L. (2009). Nanotechnology and Functional Foods: Effective Delivery of Bioactive Ingredients. Wiley-Blackwell.		

Practical based on Paper 1, 2

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: INTRODUCTION TO BIOINFORMATICS	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand Introduction to Bioinformatics. CO2: Learn about Major biological databases. CO3: Explain Sequence alignment algorithms. CO4: Describe Protein and nucleic acid structure and function prediction. CO5: Describe Specialized Microbial Databases.		
Unit 1 Introduction to Bioinformatics. Fundamentals of computer and internet. Various protocols followed on internet. DNA Sequencing techniques and advances. Applications of bioinformatics.		
Unit 2 Major biological databases. Protein, nucleic acid sequence and structure databases. Gene expression and metabolic pathway databases. Various file formats.		
Unit 3 Sequence alignment algorithms, types and applications. Phylogenetic tree construction using various algorithms. Statistical significance of sequence alignment.		
Unit 4 Protein and nucleic acid structure and function prediction. Validation of protein structure with emphasis on Ramachandran plot. Drug designing on prevalent diseases.		
Unit 5 Specialized Microbial Databases. Metagenomics, Metatranscriptomics, Metabolomics and Systems Biology. Host pathogen interaction, Comparative genomics and proteomics of microbes Microbial Bar Coding and Bioinformatics. Application of bioinformatics in identification of virus, bacterial and fungal species and strains.		
Suggested Readings (Latest Editions): 1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House. 2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications. 3. Lesk M.A. (2008) Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition. 4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication. 5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell. 6. Ghosh, Z. and Mallick, V. (2008) Bioinformatics- Principles and Applications. Oxford University Press. 7. Ghosh, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press. 8. Baxevanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc. 9. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House. 10. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons. 11. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey,U.S.: Wiley Blackwell. 12. Xiong J. (2006). Essential Bioinformatics,1st edition. Cambridge, U.K.: Cambridge University Press		



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Chaudhary Charan Singh University, Meerut

Course Name: MEDICAL BIOTECHNOLOGY AND DIAGNOSTICS TOOLS	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Introduction to medical microbiology. CO2: Biotechnological tools for pathogenic Gram-positive bacteria. CO3: Biotechnological tools for pathogenic Gram-negative bacteria. CO4: Understand the pathology of the viral, fungal and protozoan diseases.		
Unit 1 Introduction of medical microbiology: Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels		
Unit 2 Biotechnological tools for pathogenic Gram-positive bacteria: Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: <i>S. aureus</i> , <i>S. pyogenes</i> , <i>B. anthracis</i> , <i>C. perferinges</i> , <i>C. tetani</i> , <i>C. botulinum</i> , <i>C. diphtheriae</i> <i>M. tuberculosis</i> , <i>M. leprae</i> .		
Unit 3 Biotechnological tools for pathogenic Gram-negative bacteria: Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: <i>E. coli</i> , <i>N. gonorrhoea</i> , <i>N. meningitidis</i> , <i>P. aeruginosa</i> , <i>S. typhi</i> , <i>S. dysenteriae</i> , <i>Y. pestis</i> , <i>B. abortus</i> , <i>H. influenzae</i> , <i>V. cholerae</i> , <i>M. pneumoniae</i> , <i>T. pallidum</i> <i>M. pneumoniae</i> , <i>Rickettsiaceae</i> , <i>Chlamydiae</i> .		
Unit 4 Viral diseases: Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.		
Unit 5 Fungal and Protozoan diseases: Fungal and Protozoan infections. Dermatophytoses (Trichophyton, Microsporun and Epidermophyton) Subcutaneous infection (Sporothrix, Cryptococcus), systemic infection (Histoplasma, Coccidioides) and opportunistic fungal infections (Candidiasis, Aspergillosis), gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria).		
Suggested Readings (Latest Editions): 1. Brooks GF, Carroll KC, Butel JS and Morse SA 2007. Jawetz, Melnick and Adelberg's Medical Microbiology. 24th ed. McGraw Hill Publication. 2. Goering R, Dockrell, H, Zuckerman, M and Wakelin, D 2007. Mims' Medical Microbiology. 4th ed. Elsevier. 3. Willey JM, Sherwood LM, and Woolverton CJ 2008. Prescott, Harley and Klein's Microbiology. 7th ed. McGraw Hill Higher Education.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BASICS OF FORENSIC SCIENCES	Credits: 03	Course No:
Course Outcome: Upon successful completion of this course, students should be able to: CO1: Apply the Laboratory skills to participate in the career needs of Forensic community. CO2: Become trained in the laboratory skills of different division of Forensic Science. CO3: Be able to work with different R&D organizations.		
Unit 1 Principles of forensic sciences: Introduction and principles of forensic science; forensic science laboratory and its organization; tools and techniques in forensic science; branches of forensic science; causes of crime; role of <i>modus operandi</i> in criminal investigation.		
Unit 2 Injuries and deaths: Classification of injuries and their medico-legal aspects; method of assessing various types of deaths; general and individual characteristics of handwriting; examination and comparison of hand writings and analysis of ink from various samples.		
Unit 3 Explosives and ballistics: Classification of firearms and explosives; introduction to internal, external and terminal Ballistics; chemical evidence for explosives; process of documentation of crime scene by photography, sketching and field notes.		
Unit 4 Fingerprints, DNA fingerprinting and toxicology: Fundamental principles of fingerprinting; classification of fingerprints; development of fingerprints as science for identification; principle of DNA fingerprinting; application of DNA profiling in forensics; role of the toxicologist; significance of toxicological findings in forensics.		
Unit 5 Forensic biology: Nature and importance of biological evidence; significance of hair, semen and blood as biological evidences; types and identification of microbial organisms of forensic significance; identification of wood, leaves, pollens, diatoms and insects as forensic evidence.		
Suggested Readings (Latest Editions): 1. Bhasin, MK and Nath, S 2002. Role of Forensic Science in the New Millennium, University of Delhi, Delhi. 2. James, SH and Nordby, JJ 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd ed. CRC Press, Boca Raton. 3. Nanda, BB and Tiwari, RK 2001. Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi. 4. Eckert, WG editor 1997. Introduction to Forensic Sciences, 2nd ed. CRC Press, Boca Raton. 5. Tilstone, WJ, Hastrup, ML and Hald, C 2012. Fisher's Techniques of Crime Scene Investigation, 1st International ed. CRC Press, Boca Raton.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: GENE EDITING AND NEXT GENERATION SEQUENCING	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the genetic engineering. CO2: Understand the genome engineering technology. CO3: Treatment of human diseases using genome engineering. CO4: DNA sequencing methods. CO5: Next generation sequencing and applications.		
Unit 1 Introduction to genetics and genetic engineering; limitations of genetic engineering; double stranded DNA breaks and repair; homologous and non-homologous recombination; knock-ins and knock-outs.		
Unit 2 Genome engineering using Zinc Finger Nuclease (ZFN) Technology; Transcription activator-like effector nuclease (TALEN) Technology; Clustered regularly interspaced short palindromic repeats (CRISPR)/Cas9 technology: target identification, gRNA design, donor design, screening and validation;		
Unit 3 Applications in treating human diseases: Human cell engineering-Thalassemia, SCID, Hemophilia, etc; Disease modeling-Cancer, iPSc and animal models; Engineered immune cells for cancer therapy; Personalized therapy; Challenges: safety and specificity; Ethical concerns: Germ line gene editing.		
Unit 4 DNA Sequencing DNA Sequencing, First generation DNA sequencers, Drawbacks of the first generation sequencing methods.		
Unit 5 NGS Emergence of Next generation sequencing, 454 Pyro-sequencing, Illumina Genome Analyzer, Applied Biosystems Sequencing, Ion Torrent Sequencing, Polonator Technology, Nanopore Sequencing, Single Molecule Real Time DNA sequencing, Comparison of Next generation sequencing techniques, Drawbacks of NGS, NGS File formats, & applications.		
Suggested Readings (Latest Editions): 1. Brown, TA 2010. Gene Cloning and DNA Analysis, 6th ed. Wiley-Blackwell. 2. Rastogi, S and Pathak, N 2009. Genetic Engineering, 1st ed. Oxford University Press. 3. Winnacker, EL 1987. From Genes to Clones: Introduction to Gene Technology, Wiley-VCH. 4. Old, RW and Primrose, SB 2006. Principles of Gene Manipulation: An Introduction to Genetic Engineering, 7th ed. Blackwell Science Inc. 5. Chaudhuri, K 2013. Recombinant DNA Technology, TERI Press, New Delhi. 6. Primrose, SB and Twyman, RM 2006. Principles of Gene Manipulation and Genomics, 7th ed. Blackwell Publishing. 7. Pennington, SR and Dunn, MJ 2002. Proteomics: From Protein Sequence to Function, 1st ed. Viva Books Private Limited. 8. Liebler, DC and Yates III, JR 2002. Introduction to Proteomics: Tools for New Biology, 1st ed. Humana Press. 9. Hill, RG and Rang, HP 2012. Drug Discovery and Development: Technology in Transition. 2 nd ed. Churchill Livingstone. 10. Kenakin, TP 2012. Pharmacology in Drug Discovery, 1 st ed. Elsevier.		

Practical based on Paper 1, 2



चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIO-STARTUPS AND ENTREPRENEURSHIP DEVELOPMENT	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the scope and relevance of entrepreneurship. CO2: Know the detailed process of establishing and running an enterprise. CO3: Have a sound knowledge of loans and their repayment policies. CO4: Learn about the running an international entrepreneurial venture.		
Unit 1 Introduction: Meaning, needs and importance of entrepreneurship; promotion of entrepreneurship; factors influencing entrepreneurship; features of a successful entrepreneurship.		
Unit 2 Establishing an enterprise: Forms of business organization; project identification; selection of the product; project formulation; assessment of project feasibility.		
Unit 3 Financing the enterprise: Importance of finance, loans and repayments; characteristics of business finance; fixed capital management; working capital, its sources and how to move for loans; inventory; raw materials and their management.		
Unit 4 Marketing management: Meaning and Importance; marketing-mix; product management: product line, product mix; marketing research and importance of survey; physical distribution and stock management.		
Unit 5 Entrepreneurship and international business: Meaning of international business; selection of a product for international market; selection of a market for international business; export financing; institutional support for exports; Bio-business involving biotechnology and consumer acceptance of biotechnology.		
Suggested Readings (Latest Editions): 1. Holt, DH 2006. Entrepreneurship: New Venture Creation, Prentice Hall of India Pvt Ltd. 2. Kaplan, JM and Warren, AC 2016. Patterns of Entrepreneurship Management, 5th ed. 3. Gupta, CB and Khanka, SS 2017. Entrepreneurship and Small Business Management, 7th revised ed. Sultan Chand & Sons.		

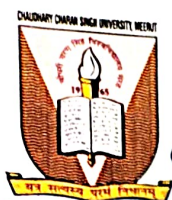
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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: INDUSTRIAL BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand about biological and biochemical technology, with a focus on biological products, the design and operation of industrial practices. CO2: Learn about fermentation technology, history, types of fermentation. CO3: Know about the diverse applications of fermentation technology in fermentation industry.		
Unit 1 Introduction to fermentation: Historical overview of fermentation; definition and role of fermentation; yeast fermentation; production of valuable biological compounds such as lactic acid, butyric acid; biofuels: Biogas, ethanol, butanol, hydrogen, biodiesel, microbial electricity; microbial insecticides.		
Unit 2 Secondary metabolites: Microbial products of pharmacological interest; steroid fermentations and transformations; over production of microbial metabolite; secondary metabolism, its significance and products; metabolic engineering of secondary metabolism for highest productivity.		
Unit 3 Enzyme immobilization: Enzyme and cell immobilization techniques in industrial processing; enzymes in organic synthesis; proteolytic enzymes and hydrolytic enzymes; enzymes in food technology and organic synthesis.		
Unit 4 Protein characterization: Purification and characterization of proteins; upstream and downstream processing; distribution of microbial cells; centrifugation, filtration of fermentation broth; liquid extraction; ion-exchange recovery of biological products.		
Unit 5 Kinetics of bioprocess: Growth kinetics of batch and continuous culture operations; mass transfer in aerobic fermentation; fundamentals of bioreactor design; scale up, mass transfer factors depending on scale up principle; metabolic engineering of antibiotic biosynthetic pathways.		
Suggested Readings (Latest Editions): 1. Casida, LE1991. Industrial Microbiology, 1st ed. Wiley Eastern Limited. 2. Stanbury, P, Whitaker, A and Hall, S 2016. Principles of Fermentation Technology, 3rd ed. Butterworth-Heinemann. 3. Crueger, W and Crueger, A 2000. Biotechnology: A Textbook of Industrial Microbiology, 2nd ed. Panima Publishing Company, New Delhi. 4. Patel, AH 2011. Industrial Microbiology, 2nd ed. Laxmi Publications.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: GENOMICS AND PROTEOMICS	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Be able to differentiate between eukaryotic and prokaryotic genomes and genome databases. CO2: Understand the genome maps of different organisms. CO3: Learn techniques used to analyze genome and proteome. CO4: Understand the relevance of genomics and proteomics in modern biology.		
Unit 1 Introduction to genomics: Introduction to Genomics, concept and scope, use of genomics in agriculture and forestry, minimal genome concept.		
Unit 2 Genome maps of important organisms: Genetics, Physical, transcription, Restriction and EST maps, NCBI genome. Model Organism's genomes and Databases: <i>E.coli</i> , <i>Mus musculus</i> , <i>Homo sapiens</i> , <i>Arabidopsis thaliana</i> ; Human genome project.		
Unit 3 Application of genomics: Comparative genomics: comparison of genomes; pharmacogenomics: variable drug response of individuals; metagenomics; epigenomics: New tool in studying complex diseases.		
Unit 4 Introduction to proteomics: Introduction to Proteomics, Two-dimensional polyacrylamide gel electrophoresis (2D-PAGE): isoelectric focusing and SDS-polyacrylamide gel electrophoresis, staining methods of 2D gels; mass spectrometry: Matrix Assisted Laser Desorption Ionization Time of Flight (MALDI-ToF); peptide mass fingerprinting; Edman degradation.		
Unit 5 Applications of proteomics: Clinical application of proteomics; proteomic biomarkers for disease diagnosis; applications of proteomics in toxicology; proteomics in plant development, protein networks, protein-protein interactions.		
Suggested Readings (Latest Editions): 1. Primrose, SB and Twyman, RM 2006. Principles of Gene Manipulation and Genomics, 7th ed. Blackwell Publishing. 2. Pennington, SR and Dunn, MJ 2002. Proteomics: From Protein Sequence to Function, 1st ed. Viva Books Private Limited. 3. Liebler, DC and Yates III, JR 2002. Introduction to Proteomics: Tools for New Biology, 1st ed. Humana Press. 4. Hill, RG and Rang, HP 2012. Drug Discovery and Development: Technology in Transition. 2 nd ed. Churchill Livingstone. 5. Kenakin, TP 2012. Pharmacology in Drug Discovery, 1 st ed. Elsevier. 6. Westermeier, R and Naven, T 2002. Proteomics in Practice: A Laboratory Manual of Proteome Analysis. 1st ed. Wiley-VCH Verlag-GmbH. 7. Lesk, AM 2014. Introduction to Bioinformatics, 4th ed. Oxford University Press.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: PHARMACEUTICAL BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Explain the strategies and various steps of the new drug discovery process. CO2: Explain the concept of pharmacodynamics and pharmacokinetics. CO3: Production of biopharmaceuticals like antibiotics, vaccines, proteins, and hormones. CO4: Understand the production and regulatory aspects in the development of pharmaceuticals. CO5: Evaluate the applications and economic considerations of biopharmaceuticals.		
Unit 1 Definition and scope of Pharmaceutical Biotechnology, sources of drugs, classification of pharmacological agents (based on chemistry, mode of action, dosage forms), route of administration, absorption and bioavailability of drugs, distribution and liver detoxification metabolism and drug excretion.		
Unit 2 General classes and properties of phyto pharmaceuticals, Extraction of phytochemicals, Phytochemical screening of medicinal plants. Bioassay guided fractionation methods- TLC, HPTLC, GC, and HPLC, Role of NMR and Mass spectrometry in drug discovery.		
Unit 3 Antimicrobial agents, Antibiotics - source, classification, mode of action, Antimicrobial resistance, and Antimicrobial activity studies (antibacterial, antiviral, antifungal and ant parasitic activity). Pharmacological Assays - In-vitro assays - chemical (anti-oxidant), Biological (anti- cancerous and assay system based on enzymes and cells), and immunological (RIA and ELISA) - In vivo assays (Anti-inflammatory and Anti-analgesic).		
Unit 4 Process of drug discovery and development- Target identification and validation, Assay development, lead optimization, pre-clinical testing, clinical trials involved in drug discovery and development, regulatory approvals and phase IV trials, High throughput screening, CPCSEA guidelines, ICMR guidelines for drug testing.		
Unit 5 Vaccines: concept, production and types - Inactivated, Attenuated, toxoid, Recombinant vaccines, Peptide and DNA vaccines, Edible vaccines, Nano drugs. Recombinant proteins, approved rDNA drugs in market, Probiotics, Nutraceuticals, Economic and legal considerations in Pharmaceutical Biotechnology.		
Suggested Readings (Latest Editions): 1. Satoskar R.S., Nirmala N. Rege, and Bhandarkar S. D. Pharmacology and Pharmaco therapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai. 2. Shoba Rani R. Hiremath, Textbook of Industrial Pharmacy, Orient Longman Pvt Ltd, 2008. 3. Crommelin Daan J. A., Sindelar D. Robert (3rd edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007. 4. Remington, The Science and Practice of Pharmacy (22nd Edition), Pharmaceutical Press, 2012. 5. Walsh, G. Biopharmaceuticals: Biochemistry and Biotechnology (2nd Edition), Wiley-Blackwell, 2013. 6. Gennaro, A. R. Remington: The Science and Practice of Pharmacy (21st Edition), Lippincott Williams & Wilkins, 2005. 7. Aggarwal, S. Essentials of Industrial Pharmacy, CRC Press, 2018. 8. Katzung, B.G. Basic and Clinical Pharmacology (14th Edition), McGraw-Hill Medical, 2018. 9. Ahuja, S. Handbook of Bioanalysis and Drug Metabolism, Academic Press, 2005.		

Practical based on Paper 1, 2

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIOETHICS AND BIOSAFETY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the scope and aspects of Bioethics and biosafety CO2: Learn the ethical implications of biotechnology and need for biosafety. CO3: Analyze the safer use of biotechnology by implanting biosafety regulations. CO4: Comprehend the ability to understand biosafety assessment procedure for biotech products.		
Unit 1 Introduction to Bioethics and Biosafety: Bioethics-Necessity of bioethics, different paradigms of bioethics- National and international ethical issues against the molecular technologies. Institutional, social, Cultural, Business and Consumer issues.		
Unit 2 Biosafety regulation guidelines: Biosafety-Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and good laboratory practices (GLP) and good manufacturing practices (GMP). Implications of biotechnological products and techniques: Bioterrorism, transgenic science, GM crops.		
Unit 3 Biosafety Regulation: Genetically modified organisms and their release in environment. Experimental protocol approvals, Laboratory associated infections and other hazards, Risk groups and assessment and levels of biosafety. Pesticides pre harvest residue management.		
Unit 4 Bioethics towards Biodiversity protection and conservation: Convention on biodiversity, Indian Biodiversity act, Legal implications, Biodiversity and farmers 'rights. Human genome project and stem cells research: Introduction, Ethical, legal and social implications of HGP. Stem Cell Research- biosafety and its ethical issues.		
Unit 5 Food and pharma safety: The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops, Environmental aspects of biotech applications. Flavr Savr Tomato as model case, Biosafety assessment of biotech pharmaceutical products.		
Suggested Readings (Latest Editions): 1. Sateesh, MK. 2010. Bioethics and Biosafety. IK International Publications. 2. Singh BD. 2010. Biotechnology: Expanding Horizons. Kalyani Publishers. 3. Thomas JA, and Fuch, RL. 2002. Biotechnology and Safety Assessment. 2002. Academic Press. 4. Fleming, DA, and Hunt, DL. 2000. Biological Safety Principles and Practices. ASM Press.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: FOOD BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the Principles of food biotechnology. CO2: Role of different microbes in food production. CO3: Microbial protein as food and feed. CO4: Bio-deterioration of food items.		
Unit 1 Principles of food biotechnology: Basic principles and application of biotechnology in food industries with regard to production, processing regulatory aspect of modern biotechnology application in food industry in the context of environment protection of human and animals.		
Unit 2 Lactic acid bacteria-put a dash distribution, classification and physiology; antimutagenic, antimicrobial and health-promoting effects; malo-lactic. Protective factors of lactic bacteria in food preservations. Yeasts and moulds associated fermented food. Technology for the production of Sauerkraut, Kimchi, Bamboo shoot, rice beer, idli, dosa, yogurt, dahi, kefir, cheese, miso, tempeh and salami, traditional fermented food of India, nutritional changes.		
Unit 3 Microbes in food technology: microbial starters for industrial production; sources, propagation, preservation, and use of starters. Improvement of starters by classical and molecular biological techniques.		
Unit 4 Microbial protein as food and feed: SCP and economics of SCP and microbial derived additive flavours and odors, Pathogenic microbes – infections; bacterial toxins and mycotoxins sources, physiological effects; methods of prevention and control in foods and feeds.		
Unit 5 Bio-deterioration of food items, Bacterial and mycotoxins, important microbes secreting toxins, chemical nature of important toxins; their role in food poisoning; physiology and mechanism of action, control of toxin contamination.		
Suggested Readings (Latest Editions): 1. Food biotechnology Ed .dietrich knorr, Marcell dekker inc. 2. Handbook of food analysis (vol I & vol II) Leo M Nollet, Marcel Dekker 3. Food microbiology _ W.C Frazier; Mc Graw Hill Book Co. 4. Modern food microbiology J. M. Jay, D. Van; Nostrand co. 5. Fermented food (7)-Ed. by A.H Rose; Academics Press 6. Microbial food poisoning _Ed.A.R. Elev. Chapman & Hall 7. Principles of enzymology for food science – whittaker ,J.R Marcle Dekker 8. Introduction to fermentation technology –Whittaker 9. Biochemical Reactors _JM Lee; Prentice Hall Inc,USA 10. Bioprocess technology: Fundamentals and application, KTH, Stocholm.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: FUNDAMENTALS OF BIOCHEMISTRY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand Biomolecules and their structure. CO2: Learn about carbohydrate metabolism CO3: Explain Protein metabolism. CO4: Describe Enzyme. CO5: Know about Nucleotides.		
Unit 1 Biomolecules: Carbohydrates -Definition, classification, structures and functions. Amino acids and Proteins- Definition, classification, structures and functions of amino acids. Essential and non-essential amino acids, formation of peptide bond. Structure of protein; primary, secondary, tertiary and quaternary structure, Ramachandran plot. Lipids- Definition, classification, structures and functions. Essential lipids.		
Unit 2 Carbohydrate metabolism: Glycolysis, Anaerobic fate of pyruvate, Krebs' cycle, Gluconeogenesis, Pentose phosphate pathway, Glycogen metabolism, Oxidative phosphorylation, Electron Transport Chain.		
Unit 3 Protein metabolism: Amino acid metabolism: Catabolism of amino acid nitrogen- Transamination, Deamination, Urea cycle. Fatty acid metabolism: Catabolism of fatty acids- β oxidation of fatty acids, ketone Bodies, α and omega oxidation		
Unit 4 Enzymes: Basics of enzyme, Properties, Mechanism of enzyme action Concept of holoenzyme, Apo enzyme prosthetic group, cofactors and coenzymes, activation energy. Michaelis Menten's equation. Significance of K_m , Lineweave-Burk Plot, Units of enzymes. Allosteric enzyme.		
Unit 5 Nucleotides: Purines and pyrimidines structures and properties. Watson – Crick Model of DNA. Purine and pyrimidine nucleotide biosynthetic pathways.		
Suggested Readings (Latest Editions): 1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York. 2. Voet D and Voet JG. (2013). Principles of Biochemistry. John Wiley and sons New York. 3. Moat AG and Foster J W (Latest Edition). Microbial Physiology. John Wiley and Sons, New York. 4. Stryer. L (2003). Biochemistry. W. H. Freeman and Co. 5. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9 th edi McGraw Hil 6. J.L. Jain (2015). Fundamentals of Biochemistry, S. Chand and Co. 7. U. Satyanarayan(2015). Biochemistry, Elsevier		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: PLANT AND ANIMAL PHYSIOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will:		
CO1: Understand plant structural organization and photosynthesis.		
CO2: Learn about plant water relations.		
CO3: Learn about digestion, respiration and working of heart.		
CO4: Understand muscles structure, excretion system and endocrine glands.		
Unit 1 The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf). Photosynthesis-Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photo respiration, compensation point.		
Unit 2 Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport. Growth and development: Definitions, phases of growth, growth curve, growth hormones. Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodism and vernalization.		
Unit 3 Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. Respiration: Exchange of gases, Transport of O ₂ and CO ₂ , Oxygen dissociation curve, Chloride shift. Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.		
Unit 4 Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation. Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neuro-transmitters.		
Unit 5 Mechanism of action of hormones (insulin and steroids). Different endocrine glands- Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.		
Suggested Readings (Latest Editions): 1. Dickinson, W.C. Integrative Plant Anatomy. Harcourt Academic Press, USA. 2. Hopkins, W.G. and Huner, P. A Introduction to Plant Physiology. John Wiley and Sons. 3. Mauseth, J.D. Plant Anatomy. The Benjamin/Cummings Publisher, USA. 4. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman and Company, New York, USA. 5. Salisbury, F. B. and Ross, C. W. Plant Physiology, Wadsworth Publishing Co. Ltd. 6. Taiz, L. and Zeiger, E. Plant Physiology, Sinauer Associates Inc. MA, USA 7. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. Harcourt Asia PTE Ltd./ W.B. Saunders Company. 8. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. John Wiley & Sons, Inc.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: MOLECULAR BIOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand Basic concepts of genome and its organisation. CO2: Learn about DNA Replication. CO3: Explain Transcription and RNA processing. CO4: Describe Gene Translation, and Regulation of Gene Expression. CO5: Describe DNA Damage and Repair.		
Unit 1: Basic concepts of genome and its organisation: Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Importance of Molecular Biology, Central Dogma of Molecular Biology. Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines. Watson and Crick model of DNA structure A, B & Z forms of DNA, Supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (T_m), hyperchromic effect. RNA structure and types of RNA. Genome and its organisation: (idea about gene, coding sequence, regulatory sequence, intron, exon, Nucleosome structure and packaging of DNA, Chloroplast DNA, Mitochondrial DNA)		
Unit 2 DNA Replication: Semiconservative nature, enzymes. Mechanism of DNA replication process in prokaryotes. Mechanism of DNA replication process in eukaryotes.		
Unit 3 Transcription and RNA processing: Transcription in prokaryotes: RNA polymerase, RNA synthesis process, Transcription in eukaryotes: Eukaryotic RNA polymerases, Difference vs prokaryotic system, mechanism of transcription initiation, promoter clearance and termination, RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.		
Unit 4 Gene Translation, and Regulation of Gene Expression: Prokaryotic and eukaryotic translation: Genetic code and its characteristics, Translation mechanism- initiation, elongation, and termination. Post-translational modifications of proteins, Gene control mechanisms: Lac & Tryptophan operon, Histone modifications, Gene Silencing.		
Unit 5 DNA Damage and Repair: DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photo reactivation, base excision repair, nucleotide excision repair, mismatch repair, recombination Repair, non-homologous end joining; Homologous recombination: models and mechanism.		
Suggested Readings (Latest Editions): 1. David P Clark (2020). Cell and Molecular Biology 2. Robert J. Brooker (2021). Genetics, Analysis and principles, Mc Graw Hill. 3. J.E. Krebs (2021). Lewin's Genes X, Jones Pub. 4. T.A. Brown (2020). Gene cloning of DNA Analysis. Wiley Blackwell. 5. J D Watson (2018), Molecular biology 6. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith (2022). Becker's Word of the cell. 7. William. D Stans Field (2022). Molecular and cell Biology, Mc Graw Hill pub. 8. Gerald Karp (2020). Cell Biology, Wiley Blackwell, Pub. 8. Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Darnell. J. Molecular Cell Biology (Fourth Edition). Media Connected - W.H. Freeman and Company. 2009 9. Cooper G M & Hausman E, The Cell - A Molecular Approach. (6th edition), Sinauer Associates 2013 10. P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi. 2012 11. Lewin. B, GENES X, (10th edition), Jones & Bartlett Learning, 2011		

Practical based on Paper 1, 2, 3



चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: ENVIRONMENTAL BIOTECHNOLOGY	Credits: 03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the role of biotechnology in providing solution to various environmental problems. CO2: Develop the concepts of biofuels and the process of bioremediation and their varied applications. CO3: Equip the student with the process of formation of bio fertilizers and learn its applications. CO4: Learn the techniques for pollution detection and biotransformation of pollutants.		
Unit 1 Basics of environmental biotechnology: Introduction to environmental biotechnology; importance of biotechnology in environmental protection; population diversity; environmental hazards; energy flow in ecological systems, energy efficiencies.		
Unit 2 Biofuels: Conventional fuels and their environmental impact: firewood, coal and gas; biofuels methanogenic bacteria, microbial hydrogen production, biogas, biodiesel, bioether, bioethanol, microbe based fuel cells.		
Unit 3 Bioremediation: Bioremediation of soil and water contaminated with oil spills; heavy metals, detergents and pesticides; phyto-remediation; degradation of lignin, cellulose, pesticides, petroleum products and other toxic chemicals by micro-organisms; treatment of municipal waste.		
Unit 4 Bio-fertilizers: Role of symbiotic and a symbiotic nitrogen fixing bacteria in the enrichment of soil; algal and fungal bio fertilizers; microphos biofertilizers; composting.		
Unit 5 Application of biotechnology in pollution control: Biotechnological methods of pollution detection: bioassay, biosensors and biological indicators; environmental genetics: derivative plasmids, environmental significance of genetically modified microbes, plants and animals.		
Suggested Readings (Latest Editions): 1. Wainwright, M 1999. An Introduction to Environmental Biotechnology, 1st ed. Springer, USA. 2. Singh, RL 2017. Principles and Applications of Environmental Biotechnology for a Sustainable Future, 1st ed. Springer Singapore 3. Kumar, R, Sharma, AK and Ahluwalia, SS 2017. Advances in Environmental Biotechnology, 1 st ed. Springer Singapore 4. Vallero, DA 2015. Environmental Biotechnology: A Biosystems Approach, 2nd ed. Academic Press.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIOTECHNIQUES - III	Credits:	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand basics of human physiology. CO2: Learn about different components of blood. CO3: Learn about immunological reactions. CO4: Learn about different enzymatic applications of microbes.		
List of Practical's 1. To study the reflex action. 2. Measurement of BMI. 3. Preparation of haemin and haemochromogen Crystals 4. Determination of ABO blood group. 5. Counting of RBC and WBC using Haemocytometer. 6. Estimation of haemoglobin. 7. Estimation of blood glucose level by using glucometer. 8. To study different mammalian blood cell types using Leishman Stain. 9. To study the Micro-organism of wound. 10. To perform the blood agglutination Test. 11. Effect of different solutions on blood cells. 12. To perform the dot-ELISA 13. To perform Indirect ELISA. 14. To perform Radial diffusion. 15. To perform Ag-Ab double diffusion method. 16. To perform Rocket electrophoresis. 17. Fermentation of organic acid through microbes. 18. Enzyme production through microbes. 19. Antibiotic sensitivity test of microbes. 20. Use of microbes in pollution treatment.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: ESSENTIALS OF IMMUNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will:		
CO1: Understand Introduction to the immune system.		
CO2: Learn about Antigens.		
CO3: Explain Vaccines immunizations.		
CO4: Describe Complement system.		
CO5: Describe Monoclonal antibodies.		
Unit 1		
Introduction to immunology: Immune Response: An overview; components of mammalian immune system; humoral and cellular immune responses; T- lymphocytes and immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells); T-cell receptors; genome rearrangements during B-lymphocyte differentiation; antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.		
Unit 2		
Antibodies: Molecular structure of immunoglobulins; regulation of immunoglobulin gene expression; clonal selection theory, allotypes and idiotypes; allelic exclusion; immunologic memory; heavy chain gene transcription; genetic basis of antibody diversity, hypotheses (germ line and somatic mutation).		
Unit 3		
Major histocompatibility complex: Major Histocompatibility complexes: class I and class II MHC; antigen processing; immunity to infection and different organisms; pathogen defense strategies; avoidance of recognition; autoimmune diseases; immunodeficiency: AIDS.		
Unit 4		
Complement system: Complement system: Classical, Lectin, Alternate; nomenclature and characteristic features of complement system; modes of activation, formation of membrane attack complex; role of complement system in immunology.		
Unit 5		
Vaccines: Vaccines and vaccination; adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents; passive and active immunization; introduction to immuno diagnostics: RIA, ELISA.		
Suggested Readings (Latest Editions):		
1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.		
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.		
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.		
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.		
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.		
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: RECOMBINANT DNA TECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the role of enzymes specifically required for gene manipulation. CO2: Learn about the most fundamental techniques like PCR, genomic and cDNA library preparation, mapping, etc required for making recombinant DNA molecules. CO3: Understand how Ti plasmid biology been utilized for making genetically modified plants.		
Unit 1 Components of gene cloning and strategies: Molecular tools and applications; restriction enzymes, ligases, polymerases, alkaline phosphatase; episomes, plasmids and other cloning vectors; bacteriophage-derived vectors, artificial chromosomes; restriction mapping; Southern and Northern hybridization; preparation and comparison of genomic and cDNA libraries; screening of recombinants.		
Unit 2 Gene transfer techniques and PCR: Gene recombination and gene transfer: transformation, microinjection, electroporation, ultra sonication; principle and applications of Polymerase Chain Reaction (PCR); primer design for PCR; Reverse Transcription-Polymerase Chain Reaction (RT-PCR).		
Unit 3 Site-directed mutagenesis: Random mutagenesis and site-directed mutagenesis; primer extension and PCR based methods of site directed mutagenesis; gene shuffling; production of chimeric proteins; protein engineering concepts and examples (any two).		
Unit 4 Transgenic technology in plants: Genetic engineering in plants; use of <i>Agrobacterium tumefaciens</i> and <i>A. rhizogenes</i> ; Ti plasmid; planttrans formation vectors; strategies for gene transfer to plant cells; direct DNA transfer to plants; gene targeting in plants; use of plant viruses as episomal expression vectors.		
Unit 5 Applications of genetic engineering: Genome mapping; DNA fingerprinting; applications of genetic engineering in animals; production and applications of transgenic mice; role of embryonic stem cells (ES cells) in gene targeting in mice; therapeutic products produced by genetic engineering: blood proteins, human hormones, immune modulators and vaccines.		
Suggested Readings (Latest Editions): 1. Brown, TA 2010. Gene Cloning and DNA Analysis, 6th ed. Wiley-Blackwell. 2. Rastogi, S and Pathak, N 2009. Genetic Engineering, 1st ed. Oxford University Press. 3. Winnacker, EL 1987. From Genes to Clones: Introduction to Gene Technology, Wiley-VCH. 4. Old, RW and Primrose, SB 2006. Principles of Gene Manipulation: An Introduction to Genetic Engineering, 7th ed. Blackwell Science Inc. 5. Chaudhuri, K 2013. Recombinant DNA Technology, TERI Press, New Delhi.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: PLANT BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand the concepts of plasticity and totipotency. CO2: Learn about different kinds of plant culture techniques. CO3: Understand how Ti plasmid biology been utilized for making transgenic plants. CO4: Get an overview of diverse applications of plant biotechnology.		
Unit 1 Introduction to plant tissue culture: Plasticity and totipotency; plant tissue culture media and growth regulators; design of a plant tissue culture lab; culture types: callus culture, protoplast culture, suspension culture; meristem and shoot tip culture; organogenesis and embryogenesis; micro propagation, its advantages and disadvantages.		
Unit 2 Somatic embryogenesis and haploid culture: Zygotic embryogenesis; somatic embryogenesis; artificial seeds; <i>in vitro</i> haploid production; androgenic methods: anther culture, microspore culture; gynogenic haploids; chromosome elimination techniques for production of haploids in cereals; endosperm culture; significance and use of haploids.		
Unit 3 Somaclonal variations, and protoplast culture: Somaclonal variations; reasons for somaclonal variations; applications of soma clonal variations; disadvantages of somaclonal variations; methods of protoplast isolation; culturing of protoplasts; protoplast fusion and somatic hybridization; cybrids; applications of somatic hybridization.		
Unit 4 Plant genetic engineering: <i>Agrobacterium tumefaciens</i> and Ti plasmid; vectors for plant transformation; direct gene-transfer methods (particle bombardment, electroporation, PEG-mediated transformation, silicon carbide fibres); chloroplast and mitochondrial DNA transformation; plant genome editing.		
Unit 5 Applications of plant genetic engineering: Generation of transgenic insect-resistant, disease-resistant, herbicide-resistant plants; increasing shelflife of fruits; pro vitamin A content enhancement in plants (e.g. Golden Rice); molecular farming; production of secondary metabolites in plant tissue culture.		
Suggested Readings (Latest Editions): 1. Bhojwani, SS and Razdan, MK 2004. Plant Tissue Culture: Theory and Practice, Revised ed. Elsevier, New Delhi. 2. Brown, TA 2010. Gene cloning and DNA analysis: An Introduction, 6th ed. Wiley-Blackwell. 3. Chawla, HS 2002. Introduction to Plant Biotechnology, 2nd ed. Science Publishers. 4. Smith, RH 2013. Plant Tissue Culture: Techniques and Experiments, 3rd ed. Academic Press, Elsevier. 5. Reinert, J and Bajaj, YPS 1977. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, Springer, Berlin. 6. Slater, A, Scott, NW and Fowler, MR 2008. Plant Biotechnology: The Genetic Manipulation of Plants, 2nd ed. Oxford University Press.		

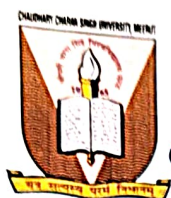
Practical based on Paper 1, 2, 3



चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: Introduction to Biostatistics	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand Introduction to Biostatistics. CO2: Learn about data collection and presentation. CO3: Learn about descriptive statistics. CO4: Learn about concept of probability and distribution. CO5: Learn about hypothesis testing and ANOVA..		
Unit 1 Introduction: Definition, scope, and applications of biostatistics in various fields like medicine, biology, and public health. Data Collection and Presentation: Methods of collecting, organizing, and presenting data using tables, graphs, and charts.		
Unit 2 Descriptive Statistics: Measures of central tendency (mean, median, mode) and dispersion (variance, standard deviation).		
Unit 3 Concepts of probability: different probability distributions (e.g., normal, binomial), and their applications. Distributions: Understanding different sampling methods and the properties of sampling distributions.		
Unit 4 Correlation and Regression Analysis: Analysing relationships between variables, including Pearson's correlation coefficient and regression analysis.		
Unit 5 Hypothesis Testing: Formulating hypotheses, conducting statistical tests (e.g., t-test, chi-square test), and interpreting results. Analysis of Variance (ANOVA): Analysing differences between group means.		
Suggested Readings (Latest Editions): 1. Gould J.F. and Gould G.F. (2001). Biostats Basic: A Student Hand Book (1 st Ed.), W.H. Freeman and Company. 2. Fowler, J. Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology, John Wiley & Sons, Ltd. 3. Cambell, R.C. (1989). Statistics for Biologists (3 rd Ed.). Cambridge University Press. 4. Sokal, R.R. and Rohlf, F.J. (1987). An Introduction to Biostatistics, W.H. Freeman and Company. 5. Mitchell, K. and Glover, T. (2001). Introduction to Biostatistics, McGraw Hill Publishing Co. 6. Raatogi, V.B. (2015). Biostatistics (3 rd Ed.), MedTech Science Press Publication, New Delhi		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIOTECHNIQUES - IV	Credits:	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Understand basics of molecular biology. CO2: Learn about preparations of different solutions and buffers. CO3: Learn about extraction of DNA/RNA and analysis through spectrophotometer and electrophoresis. CO4: Learn about PCR Analysis, restriction, cloning and transformation. CO5: Learn about applications of bioinformatics tools.		
List of Practical's 1. Acid Base Equilibrium, pH, Buffer System, Charge, pI and pKa Value and Reagent Preparation 2. DNA Extraction from any tissue/culture 3. Quantitative & Qualitative Analysis of DNA 4. Analysis of DNA by electrophoresis. 5. RNA Extraction & Optimization 5. Quantitative & Qualitative Analysis of RNA 6. Analysis of RNA by electrophoresis. 7. Primer designing 8. Optimization of PCR Reaction and PCR run 9. Analysis of Protein by SDS-PAGE and Western blot. 10. Restriction digestion. 11. Cloning and transformation. 12. Use of basic Bioinformatics tools.		

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चौधरी चरण सिंह विश्वविद्यालय, मेरठ

Chaudhary Charan Singh University, Meerut

Course Name: AGRICULTURAL BIOTECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Demonstrate an understanding of microbial diversity and its significance in agriculture. CO2: Apply marker-assisted selection techniques and transgenic breeding methods. CO3: Principles and practices of organic and integrated farming systems for sustainable agriculture. CO4: Analyze the economic implications of agricultural biotechnology and innovative technologies. CO5: Develop practical skills in soil analysis, microbial enumeration, and agricultural field assessment.		
Unit 1 Microbes in soil fertility and plant-microbe interactions. Exploration of microbial applications in agriculture, including bioremediation and biocontrol agents.		
Unit 2 Nutrient Cycles: Exploration of carbon, nitrogen, phosphorus, and sulfur cycles in Soil. Biological Nitrogen Fixation: Symbiotic, associative, and asymbiotic nitrogen fixation, including the role of Azolla, blue-green algae, and mycorrhiza. Soil Health Management: Strategies for maintaining soil health through microbial interventions and sustainable agricultural practices.		
Unit 3 Marker-Assisted Selection (MAS): Use of molecular markers in plant breeding, MAS in backcrossing, heterosis breeding, and gene introgression. Transgenic Crops: Principles of transgenic breeding, genetic modification in agriculture, and the ecological impact of transgenic plants. Genome Editing Technologies: Applications of CRISPR/Cas9 and other genome editing tools in crop improvement and trait modification.		
Unit 4 Principles of Organic Farming: Organic farming practices, including crop rotation, composting, and biological pest control. Integrated Farming Systems: Integration of crop farming with livestock Rearing, aquaculture, and agroforestry for sustainable agriculture. Agro ecology and Biodiversity: Understanding agro ecosystems, promoting biodiversity, and enhancing ecosystem services in agricultural landscapes.		
Unit 5 Economic Perspectives in Agriculture: Principles of agro-economics, cost benefit analysis, and market dynamics in agricultural biotechnology. Innovative Technologies: Exploration of emerging technologies such as precision agriculture, vertical farming, and digital agriculture in improving agricultural productivity and sustainability.		
Suggested Readings (Latest Editions): 1. Brady, Nyle C., and Ray R. Weil. The Nature and Properties of Soils, 15 th edition, Pearson, 2017. 2. Nair, P. K. R. Agroecological Innovations: Increasing Food Production with Participatory Development, Earthscan, 2007. 3. Arora, Naveen K., et al. Advances in Plant Breeding Strategies: Breeding, Biotechnology and Molecular Tools, Springer, 2015. 4. Altieri, Miguel A., and Clara I. Nicholls. Agroecology and the Search for a Truly Sustainable Agriculture, United Nations University Press, 2005. 5. Paul, Elizabeth A., and Francis Clark. Soil Microbiology, Ecology, and Biochemistry, 4th edition, Academic Press, 2014. 6. Rehman, Abdul, et al. Soil Health and Intensification of Agroecosystems, CRC Press, 2017. 7. Van Ittersum, Martin K., et al. Ecosystem Services for Agriculture: Nature's Solution to Pest Control, Springer, 2013. 8. Wani, Shabir H., et al. Plant Microbiome: Stress Response, Springer, 2018. 9. Stolton, Sue, et al. Agroecology for Food Security and Nutrition: Proceedings of the FAO International Symposium, Routledge, 2018. 10. De Datta, S. K. Principles and Practices of Rice Production, John Wiley & Sons, 1981.		

Practical based on Paper 1, 2



चौधरी चरण सिंह विश्वविद्यालय, मेरठ
Chaudhary Charan Singh University, Meerut

Course Name: BIOPROCESS TECHNOLOGY	Credits:03	Course No:
Course Outcome (CO): Upon successful completion of this course the student will: CO1: Learn about the basic concepts of bioprocess technology and culturing of microorganisms. CO2: Understand the parts and functions of the bioreactor. CO3: Learn about the thermal death kinetics microorganisms. CO4: Microbial production of compounds and its downstream processing.		
Unit 1 Introduction to bioprocess technology: Introduction to bioprocess technology; range of bioprocess technology and its chronological development; basic principle components of fermentation technology; types of microbial culture and its growth kinetics: batch, fed batch and continuous culture.		
Unit 2 Components of bioreactor and sterilization: Design of bioprocess vessels: significance of impeller, baffles, sparger; types of culture/production vessels; airlift; cyclone Column; packed tower and their application in production processes; principles of upstream processing: media preparation, inocula development and sterilization.		
Unit 3 Kinetics of bioprocess: Theories of diffusion; gas liquid mass transfer; introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa; thermal death kinetics of microorganisms.		
Unit 4 Microbial production of compounds and its downstream processing: Bioprocess measurement and control system with special reference to computer aided process control; introduction to downstream processing; product recovery and purification; microbial production of ethanol, amylase, lactic acid and single cell proteins.		
Unit 5 Application of bioprocess engineering in industries: Food industry (baker's yeast production); environmental industry (biological wastewater treatment); medical applications of bioprocess engineering.		
Suggested Readings (Latest Editions): 1. Bailey, JE and Ollis, DF 1986. Biochemical Engineering Fundamentals, 2nd ed. McGraw Hill Education 2. Doran, P. 2012. Bioprocess Engineering Principles, 2nd ed. Academic Press 3. Stanbury, PF, Whitaker, A and Hall, SJ 2006. Principles of Fermentation Technology, 2nd ed. Elsevier Science Ltd. 4. Casida, LE 1991. Industrial Microbiology, 1st ed. Wiley Eastern Limited. 5. Crueger, W and Crueger, A 2000. Biotechnology: A Textbook of Industrial Microbiology, 2 nd ed. Panima Publishing Company, New Delhi. 6. Patel, AH 2011. Industrial Microbiology, 2nd ed. Laxmi Publications.		

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