VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Jnanasagara campus, Ballari.-583105

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VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Semester	Major 1 (A)	Major 2 (B)	Major 3 (C)	Elective /Optional	Language	Compulsory / Skill Courses	Total Credits
1	**24MJBTEC1L: Cell biology and Genetics (L:T:P = 4:0:0)** **24MJBTEC1P: Cell biology and Genetics Lab (L:T:P = 0:0:4)**	B1(6) (L:T:P = 4:0:4)	C1(6) (L:T:P = 4:0:4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Constitutional Values (2) (L:T:P = 3:0:0)	26
2	**24MJBTEC2L: Microbiological Methods (L:T:P = 4:0:0)** **24MJBTEC2P: Microbiological Methods Lab (L:T:P = 0:0:4)**	B2(6) (L:T:P = 4:0:4)	C2(6) (L:T:P = 4:0:4)	-	L1(3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	Environmental Studies (2) (L:T:P = 3:0:0)	26
3	**24MJBTEC3L: Biomolecules (L:T:P = 4:0:0)** **24MJBTEC3P: Biomolecules Lab (L:T:P = 0:0:4)**	B3(6) (L:T:P = 4:0:4)	C3(6) (L:T:P = 4:0:4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-1 (2) **24MJBTEC3S: Biotechnological Skills and Analytical Techniques** / Skill Course B1/ Skill Course C1 (L:T:P = 1:0:2)	26
4	**24MJBTEC4L: Molecular and Immunobiology (L:T:P = 4:0:0)** **24MJBTEC4P: Molecular and Immunobiology Lab (L:T:P = 0:0:4)**	B4(6) (L:T:P = 4:0:4)	C4(6) (L:T:P = 4:0:4)	-	L1 (3) (L:T:P = 4:0:0) L2 (3) (L:T:P = 4:0:0)	SEC-2 (2) **24MJBTEC4S: Bioinformatics and Biostatistics**/ Skill Course B2/ Skill Course C2 (L:T:P = 1:0:2)	26

5	**24MJBTEC5L: Genetic Engineering (L:T:P = 4:0:0)** **24MJBTEC5P: Genetic Engineering Lab (L:T:P = 0:0:4)**	B5(6) (L:T:P = 4:0:4)	C5(6) (L:T:P = 4:0:4)	**24MJBTEC5E: Biotechnology for human welfare/** Elective Course B1/ Elective Course C1 (2) (L:T:P = 2:0:0)	-	SEC-3 (2) **24ERMSCI5S: Elementary Research Methodology** (L:T:P = 2:0:0)	22
6	**24MJBTEC6L: Plant and Animal biotechnology (L:T:P = 4:0:0)** **24MJBTEC6P: Plant and Animal biotechnology Lab (L:T:P = 0:0:4)**	B6(6) (L:T:P = 4:0:4)	C6(6) (L:T:P = 4:0:4)	**A24MJBTEC6E: Applications of Biotechnology in Agriculture/** Elective Course B2/ Elective Course C2 (2) (L:T:P = 2:0:0)	-	**24MJBTEC6R Elementary Research Project** (2) (L:T:P = 0:0:4)	22
Total	**36**	**36**	**36**	**04**	**24**	**12**	**148**
Total 148 Credits							

Chairman
BOS in Biotechonology (PG)UG)
Department of PG. Studies and
Research in Biotechnology
Vijayanagara Sri Krishnadevaraya
University, BALLARI - 583105.

(Dr. G. Manohara)
17/2/25

(Dr. Channabasava)

Note:

1. The curriculum for all Courses except L1, L2, Constitutional Values, Environmental values and Elementary Research Methodology will be framed by the respective Board of Studies (A/B/C). Here for example A – Physics, B – Chemistry and C – Mathematics.

2. The Curriculum for Languages L1 & L2 will be framed by respective Board of Studies (BoS) (Example Kannada/ English/ Hindi/ Sanskrit/ Telugu etc.).

3. The curriculum for Constitutional values will be framed by Board of Studies (BoS) in Political Science.

4. The curriculum for Environmental Science will be framed by special/common Board of Studies (BoS) set up by the University.

5. The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University.

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

1st Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA1L	A1 Major Theory	20	80	100	4	0	0	4	03
24MJAA1P	A1 Major Lab	10	40	50	0	0	4	2	03
24MJBB1L	2nd Major Theory-B1	20	80	100	4	0	0	4	03

24MJBB1P	2nd Major Lab-B1	10	40	50	0	0	4	2	03
24MJCC1L	3rd Major Theory-C1	20	80	100	4	0	0	4	03
24MJCC1P	3rd Major Lab-C1	10	40	50	0	0	4	2	03
24LGCC1L	Language 1	20	80	100	3	0	0	3	03
24LGCC1L	Language 2	20	80	100	3	0	0	3	03
24CVCM1L	Constitutional Values	10	40	50	2	0	0	2	1.5*
TOTAL		**140**	**560**	**700**	**20**	**0**	**12**	**26**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA1L: For Example 24MJPH1L

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language , CV – Constitutional Values

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

1 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

2nd Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA2L	A2 Major Theory	20	80	100	4	0	0	4	03
24MJAA2P	A2 Major Lab	10	40	50	0	0	4	2	03
24MJBB2L	2nd Major Theory-B2	20	80	100	4	0	0	4	03
24MJBB2P	2nd Major Lab-B2	10	40	50	0	0	4	2	03
24MJCC2L	3rd Major Theory-C2	20	80	100	4	0	0	4	03
24MJCC2P	3rd Major Lab-C2	10	40	50	0	0	4	2	03
24LGCC2L	Language 1	20	80	100	3	0	0	3	03
24LGCC2L	Language 2	20	80	100	3	0	0	3	03
24ESCM2L	Environmental Studies	10	40	50	2	0	0	2	1.5*
TOTAL		**140**	**560**	**700**	**20**	**0**	**12**	**26**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA2L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language , ES – Environmental Science

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

CM – Common Course

2 – Semester Number

L – Lecture, P - Practical

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

3rd Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA3L	A3 Major Theory	20	80	100	4	0	0	4	03
24MJAA3P	A3 Major Lab	10	40	50	0	0	4	2	03
24MJBB3L	2nd Major Theory-B3	20	80	100	4	0	0	4	03
24MJBB3P	2nd Major Lab-B3	10	40	50	0	0	4	2	03
24MJCC3L	3rd Major Theory-C3	20	80	100	4	0	0	4	03
24MJCC3P	3rd Major Lab-C3	10	40	50	0	0	4	2	03
24LGCC3L	Language 1	20	80	100	3	0	0	3	03
24LGCC3L	Language 2	20	80	100	3	0	0	3	03
24MJAA3S	Skill Course A1	10	40	50	1	0	2	2	1.5*
TOTAL		**140**	**560**	**700**	**20**	**0**	**12**	**26**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA3L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

3 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

4th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA4L	A4 Major Theory	20	80	100	4	0	0	4	03
24MJAA4P	A4 Major Lab	10	40	50	0	0	4	2	03
24MJBB4L	2nd Major Theory-B4	20	80	100	4	0	0	4	03
24MJBB4P	2nd Major Lab-B4	10	40	50	0	0	4	2	03
24MJCC4L	3rd Major Theory-C4	20	80	100	4	0	0	4	03
24MJCC4P	3rd Major Lab-C4	10	40	50	0	0	4	2	03
24LGCC4L	Language 1	20	80	100	3	0	0	3	03
24LGCC4L	Language 2	20	80	100	3	0	0	3	03
24MJAA4S	Skill Course A2	10	40	50	1	0	2	2	1.5*
TOTAL		**140**	**560**	**700**	**20**	**0**	**12**	**26**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

Course Code Description:

24MJAA4L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

4 – Semester Number

L – Lecture, P – Practical, S - Skill

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

5th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA5L	A5 Major Theory	20	80	100	4	0	0	4	03
24MJAA5P	A5 Major Lab	10	40	50	0	0	4	2	03
24MJBB5L	2nd Major Theory-B5	20	80	100	4	0	0	4	03
24MJBB5P	2nd Major Lab-B5	10	40	50	0	0	4	2	03
24MJCC5L	3rd Major Theory-C5	20	80	100	4	0	0	4	03
24MJCC5P	3rd Major Lab-C5	10	40	50	0	0	4	2	03
24MJAA5E	Elective Course A1	10	40	50	2	0	0	2	02
24RMBS5S	Elementary Research Methodology#	10	40	50	2	0	0	2	01*
TOTAL		**110**	**440**	**550**	**16**	**0**	**12**	**22**	**-**

*** 40 Multiple Choice Questions for 40 Marks (OMR Based)**

 # The curriculum for Elementary Research Methodology will be set by special/common Board of Studies (BoS - Faculty of Science & Applied Science) set up by the University. The course code for Elementary Research Methodology shall be 24RMBS5S.

Course Code Description:

24MJAA5L:

24 – Year of Curriculum Implementation / Revision

MJ – Major, LG – Language, RM – Research Methodology

AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)

BS – Bachelor of Science

4 – Semester Number, L – Lecture, P – Practical, S – Skill, E – Elective Course

VSKUB SEP Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Scheme for the Three Years B.Sc. Undergraduate Programme with effect from 2024-25 (Three Major Combination)

Structure with Course 'A' as one of the Majors

6th Semester

Course code	Title of the Course	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
		IA	SEE	Total	L	T	P		
24MJAA6L	A6 Major Theory	20	80	100	4	0	0	4	03
24MJAA6P	A6 Major Lab	10	40	50	0	0	4	2	03
24MJBB6L	2nd Major Theory-B6	20	80	100	4	0	0	4	03
24MJBB6P	2nd Major Lab-B6	10	40	50	0	0	4	2	03
24MJCC6L	3rd Major Theory-C6	20	80	100	4	0	0	4	03
24MJCC6P	3rd Major Lab-C6	10	40	50	0	0	4	2	03
24MJAA6E	Elective Course A2	10	40	50	2	0	0	2	02
24MJAA6R	Elementary Research Project	10	40	50**	0	0	4	2	01**
TOTAL		**110**	**440**	**550**	**14**	**0**	**16**	**22**	**-**

**** Internally conducted based on project report and presentation. The evaluation scheme will be provided by respective BoS.**

Course Code Description:

24MJAA6L:

24 – Year of Curriculum Implementation / Revision
MJ – Major, LG – Language, CM – Common Course,
AA/BB/CC – Course Specific (Example for Physics AA – PH, Chemistry AA – CH, Maths – MA etc.)
BS – Bachelor of Science
6 – Semester Number
L – Lecture, P – Practical, E – Elective Course, R – Research Project

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. CBCS is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the university:
   One credit (01) = One Theory Lecture (L) period of one (1) hour;
   One credit (01) = One Tutorial (T) period of one (1) hour;
   One credit (01) = One practical (P) period of two (2) hours.
   One Credit (01) = One Field Study (F) period of one (1) hour
3. Students shall select any two languages during 1-IV semesters.
4. Student shall select only one Skill course from any one of the major courses opted in 3rd and 4th semesters.
5. Student shall select Elective course from any one of the major courses opted one in each in 5th and 6th semesters.
6. Elementary Research Methodology Course is common for all B.Sc. students.
7. Student shall perform Elementary Research Project in any one of the major courses opted in 6th semester.

Abbreviation Explanations:

1. SEC: Skill Enhancement Course;
2. L1: Language One
3. L2: Language One
4. L= Lecture; T= Tutorial; P=Practical; S= Skill; E = Elective; R = Research Project
5. MJ – Major
6. LG – Language
7. RM – Research Methodology
8. CM – Common Course

NOTE:

1. FOR A THEORY COURSE WITH 4 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
2. FOR A THEORY COURSE WITH 3 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 40-42 HOURS.
3. FOR A THEORY COURSE WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 26-28 HOURS.
4. FOR A LAB COURSE/RESEARCH PROJECT WITH 2 CREDITS, SYLLABUS HAS TO SET FOR TOTAL OF 52-56 HOURS.
5. FOR A SKILL COURSE WITH 1 HOUR THEORY AND 2 HOUR LAB OF 2 CREDITS, SYLLABUS HAS TO BE SET FOR 40-42 HOURS.

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in Biotechnology

III to VI Semester Syllabus

Bachelor of Science

With effect from

2024-25 and onwards

17/02/25
Chairman
BOS in Biotechonology (PG/UG)
Department of P.G. Studies and
Research in Biotechnology
Vijayanagara Sri Krishnadevaraya
University, BALLARI - 583105.

(Dr. G Manohara)
17/2/25

(Dr. Channabasava)

Department Name: Biotechnology

Semester - III

Course Title: Biomolecules	Course Code: 24MJBTEC3L
Total Contact Hours: 56 Hrs	**No. of Credits: 04**
L:T:P: 4:0:0	
Internal Assessment Marks: 20	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Acquire knowledge about types of biomolecules, structure, and their functions
2. Will be able to demonstrate the skills to perform bioanalytical techniques
3. Apply comprehensive innovations and skills of biomolecules to biotechnology field

Unit	Description	Hours
1	**Carbohydrates:** Introduction, sources, classification of carbohydrates. Structure, function and properties of carbohydrates. Monosaccharides – Isomerism and ring structure, Sugar derivatives – amino sugars and ascorbic acid. Oligosaccharides – Sucrose and Fructose, Polysaccharides – Classification as homo and heteropolysaccharides, Homopolysaccharides - storage polysaccharides (starch and glycogen- structure, reaction, properties), structural polysaccharides (cellulose and chitin-structure, properties), Heteropolysaccharides- glycoproteins and proteoglycans (Brief study). Metabolism: Glycolysis and gluconeogenesis, Kreb's cycle, oxidative phosphorylation.	11Hrs
2	**Proteins:** Introduction, classification and structure of amino acids. Concept of – Zwitterion, isoelectric point, pK values. Essential and nonessential amino acids. Peptide bond and peptide, classification of proteins based on structure and function, Structural organization of proteins [primary, secondary (α,), tertiary and quaternary]. Fibrous and globular proteins, Denaturation and renaturation of proteins General aspects of amino acid.	11Hrs
3	**Lipids and Enzymes** Classification and function of lipids, properties (saponification value, acid value, iodine number, rancidity), Hydrogenation of fats and oils Saturated and unsaturated fatty acids. General structure and biological functions of - phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, ergosterol. Nomenclature and classification, enzyme kinetics, factors influencing enzyme activity, Coenzymes and their functions (one reaction involving FMN, FAD, NAD).	11Hrs

	Enzyme inhibition- Irreversible and reversible (competitive, non-competitive and uncompetitive inhibition with an example each).	
4	**A. Vitamins:** Water- and fat-soluble vitamins, dietary source and biological role of vitamins Deficiency manifestation of vitamin A, B, C, D, E and K **B. Nucleic acids:** Structures of purines and pyrimidines, nucleosides, nucleotides in DNA. **C. Hormones:** Classification of hormones based on chemical nature and mechanism of action. Chemical structure and functions of the following hormones: Glucagon, Cortisone, Epinephrine and testosterone	**11Hrs**
5	**Bioanalytical tools:** **a) Chromatography:** Principle, procedure and applications of - paper chromatography, thin layer chromatography, adsorption chromatography, ion exchange chromatography, gel filtration chromatography, affinity chromatography, gas liquid chromatography and high performance liquid chromatography. **b) Electrophoresis:** Principle, procedure and applications of electrophoresis (paper electrophoresis, gel electrophoresis -PAGE, SDS- PAGE & agarose electrophoresis) and isoelectric focusing. **c) Spectroscopy:** working principle and applications	**12Hrs**

References:

1. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth), 2015
2. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. Macmillon Pub, 2017
3. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan), 2015
4. Text Book of Biochemistry by West et. al., (Mac Millan), 2012
5. Principles of Biochemistry by Smith et. al., (Mc Graw Hill), 1983
6. Harper's Biochemistry (Langeman), 2018
7. Biochemistry by D.Voet and J.G.Voet (John weily).
8. Enzymes by Palmer (East), 2008
9. Biochemistry by U. Satyanarayana (Books & Allied (P) Ltd), 2008

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Department Name: Biotechnology

Semester - III

Course Title: Biomolecules Lab	Course Code: 24MJBTEC3P
Total Contact Hours: 56 Hrs	No. of Credits: 02
L:T:P: 0:0:4	
Internal Assessment Marks: 10	Duration of SEE: 03 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Analyze and identify the protein and carbohydrate concentrations by using qualitative and quantitative methods
2. Choose appropriate analytical techniques to study biomolecules at research labs and industries
3. To understand the strengths, limitations and creative use of techniques for problem solving

List of Experiments

Sl. No	Experiment
1	Introduction to basic instruments (Principle, standard operating procedure) with demonstration (instruments available in laboratory with reference to Biochemistry lab).
2	Definitions and calculations: Molarity, Molality, Normality, Mass percent % (w/w), Percent by volume (% v/v), parts per million (ppm), parts per billion (ppb), Dilution of concentrated solutions. Standard solutions, stock solution, solution of acids. Reagent bottle label reading and precautions.
3	Preparation of standard buffers by Hendersen-Hasselbach equation – Acetate, phosphate, Tris and determination of pH of solution using pH meter.
4	Determination of α-amylase activity by DNS method
5	Estimation of proteins by Bradford method
6	Extraction of protein from soaked/sprouted green gram by salting out method
7	Separation of plant pigments by circular paper chromatography
8	Separation of amino acids by thin layer chromatography
9	Determination of iodine number of lipids

References:

1. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu.Pvt.Ltd. New Delhi, India
2. Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
3. Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing. House, New Delhi, ISBN 81-7319-302-9
4. Experimental Biochemistry: A Student Companion, BeeduSasidharRao& Vijay Despande(ed).I.K International Pvt. LTD, NewDelhi. ISBN 81-88237-41-8
5. Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067.

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Department Name: Biotechnology

Semester - III

Course Title: Biotechnological Skills and Analytical Techniques	Course Code: 24MJBTEC3S
Total Contact Hours: 30 Hrs	No. of Credits: 02
L:T:P: 1:0:2	
Internal Assessment Marks: 10	Duration of SEE: 1hr, 30 Min
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
2. To acquire knowledge on the different chromatographic methods for separation of biological products.

Unit	Description	Hours
1	**Introduction to Biotechnology Lab:** Biotechnology Industry in Indian and Global context -organization in context of large /medium/ small enterprises, their structure and benefits. **Methods and practices of cleaning and management of lab:** Learning and Practice of Integrated clean-in-place (CIP) and sterilize-in-place (SIP) as per industry standards, material requirements for cleaning specific area, equipment, ventilation area, personal protective requirements. **Procedure of cleaning and storage of Lab ware:** Methodology for storage area, cleaning procedure and materials to be used for various surfaces. Sign boards, labelling do's & don'ts. Knowledge about standard procedures of cleaning or glass ware, plastic ware. Maintenance of inventory. **Principles and practices of lab safety:** Knowledge about safety symbols and hazard signs. Personal safety gears, utility, and disposal. Equipment safety protocols, chemical safety protocols. Documentation of chemical and equipment usage records. Handling hazardous chemicals.	15Hrs
2	**Best practices of usage and storage of chemicals:** Knowledge and practice in handling of chemicals, labelling and stock maintenance. SOP and material handling. Procedures to maintain chemicals, labelling, storage, and disposal. **Preparation of solutions and standards:** Properties and uses of chemicals commonly used in life sciences laboratories. Maintaining safety standards for handling various solutions and chemicals. Preparation of test reagents and buffers, Protocols for proper mixing of chemicals. Safety precautions while preparation and storage of incompatible chemicals and reagents.	15Hrs

	Preparation of media: Maintenance and storage of purified water for media (Plant Tissue culture media, Microbiological media, and Animal cell culture media) preparation. Practical methods for decontamination and disposal: Decontamination methods, Safe disposal practices of decontaminated media or materials. **Laboratory record writing:** Method of record writing, data collection and recording, reporting of result, discussion of result, summary writing, effective PowerPoint presentation taking any experiment as example.	

References:

1. Rajeev Roy (2011) Entrepreneurship (2nd Ed) Oxford University Press
2. John Mullins (2013) The New Business Road Test (4th Ed) Financial Time series.
3. Denise M. Harmening. Laboratory Management, Principles and Processes, D.H. Publishing & Consulting Inc.; Third Edition, 2012
4. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
5. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K.Upadhyay, and N. Nath
6. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor,Publisher: Horwood Pub. Co., England.
7. Analytical Biochemistry, 3rdedition, (1998), David Holmes, H. Peck, Prentice-Hall, UK

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Department Name: Biotechnology

Semester - IV

Course Title: Molecular and Immunobiology	Course Code: 24MJBTEC4L
Total Contact Hours: 56 Hrs	**No. of Credits: 04**
L:T:P: 4:0:0	
Internal Assessment Marks: 20	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Study the advancements in molecular biology with latest trends.
2. Will acquire the knowledge of structure, functional relationship of proteins and nucleic acids.
3. Demonstrate comprehension of the underlying structure and function of the immune system and related disorders.
4. Demonstrate an understanding of the role of cells and molecules in immune reactions and responses
5. Understand the fundamental concepts of immunity, and the contributions of the organs and cells in immune responses.

Unit	Description	Hours
1	**Molecular basis of life and Nucleic Acids:** Introduction to DNA and experimental proof as genetic material and types of DNA. Structure and functions of DNA: Watson and Crick model of DNA and other forms of DNA (A and Z). RNA: types, structure and functions.	11Hrs
2	**DNA Replication:** Replication of DNA in prokaryotes and eukaryote– Enzymes and proteins involved in replication. Polymerases and all enzyme components. The replication complex: Pre-primming proteins, primosome, replisome, unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA damage and Repair mechanism, photo reactivation, excision repair, mismatch repair and SOS repair.	11Hrs
3	**Transcription and Translation:** Transcription in prokaryotes role of sigma factor, promoter, initiation, elongation and termination of RNA chains. Transcription in eukaryotes. mechanism of transcription. Translation- in prokaryotes and eukaryotes- ribosome, enzymes and factors involved in translation. Mechanism of translation- activation of amino acid, aminoacyl tRNA synthesis, Mechanism- initiation, elongation and termination of polypeptide chain. Post translational modifications of proteins.	12Hrs

4	**Cells and Organs of the Immune System:** Introduction to the Immune System. Types of Immunity: first and second line of defence, innate and acquired/adaptive immunity, specificity, diversity, Self and non-self-recognition. Cells of the immune system: Antigen-presenting cells (APCs), Role of B and T-lymphocytes in Humoral immunity and cell-mediated immunity, primary and secondary immune response, Immunization, memory. Organs of the Immune system: Thymus, bone marrow, spleen, Lymph Node, peripheral lymphoid organs	**11Hrs**
5	**Antigen-Antibody Reactions and Immunotechniques:** Structure and properties of antibodies and antigens (iso- and allo-antigens), antigen specificity, haptens, and adjuvants. Biomolecular association, Cross-reactivity, Precipitation, Agglutination reactions. ELISA, ELISpot Assay, RIA. Immunocytochemistry, Fluorescent Techniques, FACS. Hybridoma Technology	**11Hrs**

References:

1. Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press
2. Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA
5. Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA
6. Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K
7. Textbook of Immunology, Paul Ajoy, Books and Allied (P) Ltd., 2016
8. Kuby Immunology. Kindt T.J. et at., W.H. Freeman & Co. 2018
9. Cellular and Molecular Immunology. Abbas, A.K. et al., Elsevier Saunders Co., 2015
10. Essential Immunology. Riott, I.M., Blackwell Scientific Publications, 1994
11. Immunology. Riott, I.M., Brostoff J., Male, D. Mosby Pub., 2017
12. Immunobiology. Janeway C.A. and Travers, P. Churchill Livingstone Pub., 2016
13. Instant Notes in Immunology. Lydyard PM et al. Viva Books Pvt. Ltd., 2011
14. Abbas AK, Lichtman AH, and Pillai S. (2019). Basic Immunology- Functions and Disorders of the Immune System. Elsevier,

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Department Name: Biotechnology

Semester - IV

Course Title: Molecular and Immunobiology Lab	Course Code: 24MJBTEC4P
Total Contact Hours: 56 Hrs	**No. of Credits: 02**
L:T:P: 0:0:4	
Internal Assessment Marks: 10	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Apply skills in molecular biology that are generally useful in biological and medical research.
2. Demonstrate an understanding of some basic molecular techniques
3. Demonstrate nucleic acid extraction, resolution, and detection.
4. Demonstrate technical skills in immunological tools and techniques
5. Apply the domain-specific knowledge and skills acquired in immunology for innovative therapies and Immunotechnologies

List of Experiments

Sl.No	Experiment
1	Estimation of DNA by DPA method
2	Estimation of RNA by Orcinol method
3	Column chromatography – gel filtration (Demo)
4	Extraction and partial purification of protein from plant source by Ammonium sulphate precipitation.
5	Hemagglutination of ABO Blood groups
6	Determination of Rh factor
7	Whole Count of WBC using Hemocytometer
8	Study on cells of the Immune System
9	Radial immunodiffusion
10	Ouchterlony double diffusion
11	ELISA – (Demo)
12	Serum Immunoelectrophoresis-(Demo)
13	Western Blotting-(Demo)

References:

1. Molecular Cloning, Laboratory Manual, Maniatis, E.F. Fritsch and J. Sambrook (Cold Spring Harber Laboratory, New York).
2. Techniques in Molecular Biology (1992), J. Walker and W. Castra (GeomHelns, London).
3. Practical Methods in Molecular Biology (1991), R.F. Schecleif and PC. Wensik (SpringerVerlag).
4. Sharma AK & A Sharma. 1980. Chromosome techniques: Theory & Practice. Batterworth.
5. Handbook of Experimental Immunology, Vol. 1 & 2, Weir D.M., Wiley, 1997
6. Practical Immunology. Hudson L. and Hay F.C., Blackwell Scientific Pub., 1989

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Department Name: Biotechnology

Semester – IV

Course Title: Bioinformatics and Biostatistics	Course Code: 24MJBTEC4S
Total Contact Hours: 30 Hrs	**No. of Credits: 02**
L:T:P: 1:0:2	
Internal Assessment Marks: 10	**Duration of SEE: 1hr, 30 Min**
Semester End Exam Marks: 40	

Course Outcomes (Cos):

At the end of the course, students will be able to:

1. Remember, understand and apply the skills gained, in basic concepts of bioinformatics including databases, database searches and role of internet in bioinformatics.
2. Understand, analyze and evaluate methods to characterize and manage the different types of biological data and gain an insight into the basics of sequence alignment and analysis.
3. Remember, understand and apply basic concepts in biostatistics exemplifying sampling methods, graphical representation of data, measuring central tendencies and dispersion
4. Understand, apply and evaluate hypothesis testing using statistical methods for analyzing one or two variables, interpret and explain a p-value, perform a two-sample t-test and interpret the results.

Unit	Description	Hours
1	**Bioinformatics definition, history, scope and applications** **Bioinformatics web portals:** NCBI, EBI, ExPASy **Biological databases:** Classification of databases – primary (Genbank), secondary (PIR) and tertiary or composite (KEGG) databases **Sequence databases** – DNA sequence databases (ENA,DDBJ) **Protein sequence databases** (Swissprot, PROSITE) **Basics of sequence alignment** – match, mismatch, gaps, gap penalties, scoring alignment **Types of sequence alignment** – pairwise and multiple alignment, local and global alignment **Dot matrix comparison of sequences** **Concepts of phylogeny** – Distance based (NJ method) and character based (ML method) tree construction methods	**15Hrs**
2	**Introduction to Biostatistics, kinds of data and variables –** based on nature (numerical discreetee and continuous, categorical-ordinal and nominal) – based on source (primary and secondary data), sample size, sampling methods and sampling errors	**15Hrs**

	Data tabulation and representation methods: graphical methods– stem and leaf plot, line diagram, bar graphs, histogram, frequency polygon, frequency curves; diagrammatic method- pie diagram **Measures of central tendency**- mean, median, mode; merits and demerits **Measures of dispersion**- range, variance, standard deviation, standard error and coefficient of variation; merits and demerits Correlation and regression analysis and their applications to biology **Hypothesis testing**- steps in testing for statistical hypothesis, null and alternative hypothesis, level of significance- type-1 and type-2 errors **Test of significance for large samples**- Z-test for means and proportions **Test of significance for small samples**- student's t-test(one sample and two samples) **Chi-square test and its applications**- goodness of fit (not based on distribution), test of independence **Analysis of variance (One-way ANOVA)** and their applications to biology	

References:

1. Khan &Khanum (2004), Fundamentals of Biostatistics, II Revised Edition, UkaazPublication
2. Bailey, N.T.J ,Statistical methods in Biology, Cambridge Univ.Press
3. Fundamentals of Biostatistics, P Hanmanth Rao and K.Janardhan
4. Danial, W. W ,Biostatistics, Wiley
5. Introduction to Bioinformatics By Aurther M lesk
6. Developing Bioinformatics Computer Skills By: Cynthia Gibas, Per Jambeck
7. Bioinformatics second edition By David Mmount
8. Essential Bioinformatics By JinXiong
9. Bioinformatics Computing By Bryan Bergeron
10. Bioinformatics: Concepts, Skills & Applications By R.S.Rastogi

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Department Name: Biotechnology

Semester - V

Course Title: Genetic Engineering	**Course Code: 24MJBTEC5L**
Total Contact Hours: 56 Hrs	**No. of Credits: 04**
L:T:P: 4:0:0	
Internal Assessment Marks: 20	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Demonstrate a thorough understanding of the fundamental principles and techniques of genetic engineering.
2. Apply the knowledge of genetic engineering to diverse applications in agriculture, medicine, biotechnology, and environmental science.
3. Analyze and interpret genetic data using bioinformatics tools for a comprehensive understanding of gene function and evolutionary relationships.
4. Evaluate genetic engineering's ethical, social, and legal implications and propose responsible solutions.
5. Stay updated with recent advancements in genetic engineering, critically evaluate emerging trends, and assess their potential impact on various fields.

Unit	Description	Hours
1	**Fundamentals of Genetic Engineering-I:** Introduction to Genetic Engineering - Definition, scope, and historical overview of genetic engineering. Importance and applications in various fields. DNA Structure and Manipulation - Structure and organization of DNA molecules. Techniques for DNA isolation and purification. RNA Analysis and Gene Expression- Methods for RNA isolation and purification. Analysis of gene expression using techniques such as Northern hybridization. Introduction to Polymerase Chain Reaction (PCR) and its variants for gene expression analysis.	**12Hrs**
2	**Fundamentals of Genetic Engineering-II:** Recombinant DNA technology – Introduction to molecular cloning. Overview of cloning vectors. Plasmids, phage, cosmid, BAC, and YAC. Features and	**11Hrs**

	applications of cloning vectors in genetic engineering. Enzymes used in recombinant DNA technology: Restriction endonucleases, DNA modifying enzymes, other nucleases, Polymerases, Ligase, kinases, and phosphatases. Techniques for molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.	
3	**Practices in Genetic Engineering:** Techniques - Protein Expression and Purification. Techniques for expressing recombinant proteins using bacterial, animal, and plant expression systems. Strategies for protein purification and characterization Gene Manipulation Techniques - Methods of gene delivery. Physical, chemical, and biological methods. transformation, transfection, electroporation, and micro-injection. Gene knockout techniques in bacterial and eukaryotic organisms. Genome Editing - Introduction to genome editing techniques- Principles and applications of genome editing techniques.	**11Hrs**
4	**Applications of Genetic Engineering:** Gene therapy and its potential in treating genetic disorders. Strategies for gene delivery in therapeutic applications. Diagnostic Applications. DNA fingerprinting and its applications in forensics. Molecular diagnostic techniques and their role in disease diagnosis. Use of genetic engineering in the development of therapeutics and vaccines. Crop Improvement and Biotechnology in Agriculture. Genetic engineering for crop improvement, including enhanced traits and disease resistance. The role of biotechnology in sustainable agriculture.	**11Hrs**
5	**Advances in Genetic Engineering:** Industrial Applications, such as enzyme production, biofuel production, and bioremediation. Scale-up techniques and process optimization in industrial settings. Introduction to synthetic biology and its integration with genetic engineering. Design and construction of artificial biological systems	**11Hrs**

References:

1. Principles of Gene Manipulation and Genomics (2016) 8th ed., Primrose, SB, and Twyman, R, Wiley Blackwell, ISBN: 978-1405156660.
2. Gene Cloning and DNA Analysis: An Introduction (2019) 7th ed., Brown, TA, Wiley Blackwell, ISBN: 978-1119072560.
3. Genome 4 (2017) 4th ed., Brown, TA, Garland Science, ISBN: 978-0815345084.
4. Introduction to Genomics (2015) 2nd ed., Lesk, AM, Oxford University Press India, ISBN: 978-0198745891.
5. Genomics and Personalized Medicine: What Everyone Needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN: 978-0190234768.
6. Molecular Biology of the Gene (2014) 7th ed., Watson, JD, Baker, TA, Bell, SP, Gann, A, Levine, M, and Losick, R, Pearson, ISBN: 978-0321762436.
7. Principles of Gene Manipulation and Genomics (2019) 9th ed., Primrose, SB, and Twyman, R, Wiley Blackwell, ISBN: 978-1119163774.
8. Genomes (2018) 4th ed., Brown, TA, Garland Science, ISBN: 978-0815345084.
9. Introduction to Genomics and Proteomics (2015) 2nd ed., Burrell, MM, Wiley, ISBN: 978-0470850075.
10. Molecular Genetics and Genomics (2020) 1st ed., Krebs, JE, and Goldstein, ES, Jones & Bartlett Learning, ISBN: 978-1284154544.
11. Bioinformatics and Functional Genomics (2015) 3rd ed., Pevsner, J, Wiley-Blackwell, ISBN: 978-1118581780.

12. Genomic Approaches for Cross-Species Extrapolation in Toxicology (2019) 1st ed., Wichard, J, and Maertens, A, CRC Press, ISBN: 978-0815348023.
13. Introduction to Genetic Analysis (2020) 12th ed., Griffiths, AJF, Wessler, SR, Carroll, SB, and Doebley, J, W.H. Freeman, ISBN: 978-1319149609.
14. Genetic Engineering: Principles and Methods (2019) 3rd ed., Fowler, MR, CABI, ISBN: 978-1789240605.

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Department Name: Biotechnology

Semester -V

Course Title: Genetic Engineering Lab	**Course Code: 24MJBTEC5P**
Total Contact Hours: 56 Hrs	**No. of Credits: 02**
L:T:P: 0:0:4	
Internal Assessment Marks: 10	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Perform laboratory procedures and develop practical skills in genetic engineering techniques.
2. Explain gene expression regulation mechanisms and apply genetic modification methods effectively.

List of Experiments

Sl.No	Experiment
1	**Introduction to Laboratory Techniques –** Safety guidelines and laboratory protocols Aseptic techniques and proper handling of materials. Basic equipment and instrument operation Preparation of reagents and media
2	**Nucleic Acid Extraction and Quantification-** DNA extraction from different sources (e.g., bacteria, plant, animal). RNA extraction and purification methods. Quality assessment and quantification of nucleic acids (spectrophotometry, gel electrophoresis).
3	**Polymerase Chain Reaction (PCR)** Primer design and optimization PCR setup and cycling conditions Agarose gel electrophoresis for PCR product analysis
4	**Cloning and Plasmid Manipulation** Isolation of Plasmid Restriction enzyme digestion Ligation reactions Transformation of bacterial cells with recombinant plasmids Colony selection and screening for successful cloning
5	**Gel Electrophoresis and DNA Analysis** Agarose gel electrophoresis for DNA fragment separation and analysis DNA size determination using molecular weight markers

	DNA band visualization techniques (e.g., Ethidium bromide staining, DNA intercalating dyes)

References:

1. Genetic Engineering: Principles and Methods (2019) 3rd ed., Fowler, MR, CABI, ISBN: 978-1789240605.

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Department Name: Biotechnology

Semester - V

Course Title: Biotechnology for human welfare	Course Code: 24MJBTEC5E
Total Contact Hours: 42 Hrs	**No. of Credits: 02**
L:T:P: 2:0:0	
Internal Assessment Marks: 10	**Duration of SEE: 1hr**
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Identify and distinguish between organic and GM foods and their benefits.
2. Summarize the applications of biotechnology in aqua/marine culture and to assess the impact of biofouling.
3. Translate, develop, and evaluate the applications of Nanodevices and Nanomedicines in drug delivery.
4. Interpret, design, and develop marketing and export of biotechnological products

Unit	Description	Hours
1	**Environment: Application of biotechnology in environmental aspects:** Degradation organic pollutants – chlorinated and non-chlorinated compounds; degradation of hydrocarbons and agricultural wastes, PHB –production and its futuristic applications.	14Hrs
2	**Industry: Application of biotechnology in industry:** Industrial production of alcoholic beverages (wine), antibiotics (Penicillin), enzymes (lipase). Applications in food, detergent and pharmaceutical industry.	14Hrs
3	**Forensic science:** Application of biotechnology in forensic science: Solving crimes of murder and rape; solving claims of paternity and theft by using DNA finger printing techniques	07Hrs
4.	**Health:** Application of biotechnology in health: Genetically engineered insulin, recombinant vaccines, gene therapy, molecular diagnostics using ELISA, PCR; monoclonal antibodies and their use in cancer; human genome project.	07Hrs

References:

1. Bhasin M.K. and Nath, S. (2002). Role of Forensic Science in the New Millennium, University of Delhi, Delhi
2. Crueger W. and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Ed., Panima Publishing Co. New Delhi.

3. Eckert W.G. (1997) Introduction to Forensic Sciences, 2nd Ed., CRC Press, Boca Raton
4. James S.H. and Nordby, J.J. (2005). Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton
5. Joerdening H.-J. and Winter J. (2005). Environmental Biotechnology – Concepts and Applications,
6. Mohapatra, P.K. (2006) Textbook of Environmental Biotechnology, I.K. International Publishing House Pvt. Ltd., New Delhi
7. Nanda B.B. and Tiwari R.K. (2001). Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi
8. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
9. Stanbury P.F, Whitaker A and Hall S.J. (2006). Principles of Fermentation Technology. 2nd Ed., Elsevier Science Ltd.

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Department Name: Biotechnology

Semester - VI

Course Title: Plant and Animal biotechnology	Course Code: 24MJBTEC6L
Total Contact Hours: 56 Hrs	**No. of Credits: 04**
L:T:P: 4:0:0	
Internal Assessment Marks: 20	**Duration of SEE: 03 Hours**
Semester End Exam Marks: 80	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Demonstrate a comprehensive understanding of plant biology, physiology, genetics, and molecular biology.
2. Apply biotechnological tools and techniques used in plant research and agriculture, such as plant tissue culture, genetic engineering and transgenics.
3. Utilize bioinformatics tools and databases to analyze and interpret plant genomic and transcriptomic data.
4. Apply knowledge about ethical considerations and regulatory frameworks associated with plant biotechnology and genetically modified crops.
5. Apply acquired knowledge and problem-solving skills to address real-world challenges in agriculture, food security, and environmental sustainability using plant biotechnology approaches.

Unit	Description	Hours
1	**Plant Tissue culture:** Introduction, history, definition, and concept of totipotency. Principles of plant tissue culture-cytodifferentiation and morphogenesis, Media and laboratory organization. Techniques – Organ culture (meristem and embryo), callus culture, Somatic embryogenesis and synthetic seeds. Haploid culture – Anther, Pollen and Ovule culture, A brief account on protoplast culture and somatic hybridization. Somaclonal variation.	**11Hrs**
2	**Secondary metabolites-** *In vitro* secondary metabolite production, Suspension cultures, cell cultures, growth vs secondary metabolite production, bioreactors and scaling up of secondary metabolite production, limitations, and applications. Production of (Shikonin and Ginseng).	**11Hrs**
3	**Transgenic Plants and Biofertilizers:** Overview of transgenic plants and their significance in agriculture. - Techniques	**11Hrs**

	for introducing foreign genes into plants: Agrobacterium-mediated transformation, biolistic, microinjection, electroporation and chemical mediated transformation. Role of reporter genes in screening and selection. Plant Molecular markers. Applications of Transgenic Plants - Improved crop traits through genetic engineering: pest resistance, herbicide tolerance, disease resistance, and abiotic stress tolerance. Biofertilizers- Rhizobium, Micorrhiza, Azolla	
4	**Animal Cell culture methods:** History and laboratory organization, Media. Cell types and culture characteristics. Pluripotency, Multipotency, Differentiation, Trans differentiation and Reprogramming. Biology and characterization of cultured cells- cell adhesion, proliferation, differentiation, morphology of cells, and identification. The basic technique of mammalian cell culture *in vitro*, Measuring parameters of growth in cultured cells, cell viability, and cytotoxicity. Large-scale culture of cell lines-monolayer, suspension, and immobilized cultures. Organ and histotypic culture-Technique, advantages, limitations, applications. Stem cells: types (embryonic, adult, induced pluripotent), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues.	**12Hrs**
5	**Transgenic animals and cloning:** Gene constructs, promoter/ enhancer sequences for transgene expression in animals. Selectable markers for animal cells- thymidine kinase and CAT. Transfection of animal cells- calcium phosphate coprecipitation, electroporation, lipofection, peptides, direct DNA transfer, viral vectors, Retrovirus, microinjection. Transgene identification methods. Transgenic and genome-edited animals- Ethical issues in transgenesis. Manipulation of animal reproduction and characterization of animal genes, Embryo transfer in cattle and applications. Somatic cell cloning - cloning of Dolly. Ethical issues.	**11Hrs**

References:

1. Bhojwani, S.S., and Razdan, M.K. (2004). Plant Tissue Culture: Theory and Practice. Amsterdam: Elsevier Science.
2. Brown, T.A. (2010). Gene Cloning and DNA Analysis: An Introduction. 7th edition. Oxford: Wiley-Blackwell.
3. Gardner, E.J., Simmons, M.J., and Snustad, D.P. (2008). Principles of Genetics. 10th edition. Hoboken, NJ: John Wiley & Sons.
4. Glick, B.R., and Pasternak, J.J. (2018). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th edition. Washington, DC: ASM Press.
5. Raven, P.H., Johnson, G.B., Losos, J.B., and Singer, S.R. (2013). Biology. 10th edition. New York, NY: McGraw-Hill Education.
6. Reinert, J., and Bajaj, Y.P.S. (1997). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Berlin: Springer.
7. Russell, P.J. (2013). iGenetics: A Molecular Approach. 3rd edition. Boston, MA: Benjamin Cummings.
8. Slater, A., Scott, N.W., and Fowler, M.R. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford: Oxford University Press.
9. Verma, A., & Singh, A. (2013). Animal Biotechnology. Elsevier. ISBN: 978-0124160026.Glick,
10. B.R., & Pasternak, J.J. (2009). Molecular Biotechnology (4th ed.). ASM Press. ISBN:978-1555814984.
11. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002

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Department Name: Biotechnology

Semester - VI

Course Title: Plant and Animal biotechnology Lab	Course Code: 24MJBTEC6P
Total Contact Hours: 56 Hrs	No. of Credits: 02
L:T:P: 0:0:4	
Internal Assessment Marks: 10	Duration of SEE: 03 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Execute plant tissue culture techniques for callus induction, somatic embryogenesis, and micropropagation, and apply them in plant breeding and propagation.
2. Perform plant transformation methods and demonstrate the ability to introduce foreign genes into plants using different techniques.

List of Experiments

Sl.No	Experiment
1	Laboratory organization of basic and commercial plant tissue culture
2	Media preparation (MS, B5), solid media preparation, and Liquid media preparation
3	Explant preparation – Leaf, bud, rhizome, and meristem
4	Synthetic seed production
5	Callus culture- Initiation and establishment of different types of callus cultures
6	Micropropagation with a suitable example – Stage 0. 1, 2, 3, and 4
7	Staining, cell viability, and cell count of cell cultures
8	Preparation of cell culture media: Preparation of basic cell culture media, such as Dulbecco's Modified Eagle Medium (DMEM), antibiotics, and other required additives.
9	Extraction of serum
10	Aseptic techniques and sterile handling: Practicing aseptic techniques, including properly handling tools and equipment, working in a laminar flow hood, and maintaining sterility throughout the cell culture process.
11	Filter sterilization: Practice filter sterilization for sensitive media ingredients.

12	Cell counting and viability assessment: Count cells using a hemocytometer or automated cell counter, and perform viability assays (e.g., trypan blue exclusion) to determine the percentage of viable cells.
13	Cell staining and microscopy: Staining the cultured cells using dyes such as hematoxylin and eosin (H&E), and observe them under a light microscope to study cell morphology and structure.

References:

1. Sambrook, J., Fritsch, E.F., and Maniatis, T. (1989). Molecular Cloning: A Laboratory Manual. 2nd edition. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Smith, R. (2012). Plant Tissue Culture: Techniques and Experiments. 3rd edition. San Diego, CA: Academic Press.

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Department Name: Biotechnology

Semester - VI

Course Title: Applications of Biotechnology in Agriculture	Course Code: A24MJBTEC6E
Total Contact Hours: 42 Hrs	**No. of Credits: 02**
L:T:P: 2:0:0	
Internal Assessment Marks: 10	**Duration of SEE: 1hr**
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. Understand the biotechnological applications in agriculture
2. Understand the importance of biotechnological methods such as plant tissue culture
3. Comprehend the pros and cons of GM crops and their plant products
4. Appreciate the biotechnological applications for effective pest control and crop Improvements

Unit	Description	Hours
1	**Agricultural Biotechnology:** Concepts and scope of biotechnology in Agriculture. Plant tissue culture, micro propagation, entrepreneurship in commercial plant tissue culture. Banana tissue culture – primary and secondary commercial setups, small scale bio-enterprises: Mushroom cultivation	14Hrs
2	**Transgenic plants:** The GM crop debate – safety, ethics, perception and acceptance of GM crops GM crops case study: BT cotton, BT brinjal. Plants as bio-factories for molecular pharming; edible vaccines, plantibodies, nutraceuticals.	14Hrs
3	**BT based pesticides:** Baculovirus pesticides, Mycopesticides, Post-harvest Protection: Antisense RNA technology for extending shelf life of fruits and shelf life of flowers. Genetic engineering for quality improvement: Seed storage proteins, Flavors– capsaicin, vanillin	14Hrs

References:

1. Chrispeels M.J. and Sadava D.E. (1994) Plants, Genes and Crop Biotechnology, 2nd Ed., Jones and Bartlett Publishers, Boston.
2. Gamborg O.L. and Philips G.C. (1998) Plant cell, tissue and organ culture, 2nd Ed., Narosa Publishing House. New Delhi.
3. Gistou, P. and Klu, H. (2004). Handbook of Plant Biotechnology (Vol. I & II). John Publication.
4. Hammond J., McGarvy P. and Yusibov.V. (2000). Plant Biotechnology, Springer Publ.
5. Heldt. H.-W. (1997). Plant Biochemistry and Molecular Biology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.

6. Kyte, L., Kleyn, J., Scoggins, H., and Bridgen M. (2003) Plants from test tubes. An introduction to micropropagation, 4th Ed., Timber Press, Portland.
7. Murray D.R. (1996) Advanced methods in plant breeding and biotechnology. Panima Publishing Corporation.
8. Nickoloff, J.A. (1995). Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana Press Incorp, USA.
9. Sawahel, W.A. (1997). Plant genetic transformation technology. Daya Publishing House, Delhi.

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Modalities of Elementary Research Project to be carried by UG students during 6th semester

Course	**B.Sc. Biotechnology 6th semester**	
Subject	Elementary Research Project	
Code	24MJBTEC6R	
L-T-P	0-0-4	
Suggestive topics	Fungal Biotechnology and Bio-pesticides/Enzyme and Microbial Technology/Biocatalysts/Biosensor & Biofuel cell/Single cell proteins/ Biological Control of Insect Pests/Soil microbiology/Environmental bioremediation/Bioprocess development (upstream to downstream)/ Nanobiotechnology/Green technology/Phytopharmacology/Medical Biotechnology/ other area related to biotechnology	
Selection of Topics	Based on current issues and possibilities to perform in-house/field visit may be finalized in consultation with respective guide	
Time and Duration	The students should complete the research project during vacation soon after 5th semester/weekly 4hour during weekend and arrange to submit the report during the 6th semester (Max. 5 students per group)	
Mode of evaluation in SEE	**Final presentation of complete project report (Power point presentation)**	**10 Marks**
	Viva-voce	**10 Marks**
	Final report	**20 Marks**
	Total	**40 Marks**

IA (10M): Presentation

IA-1 (Presentation): Finalization of topic, framing objectives, Review of literature, Methodology, expected outcome	**05 Marks**
IA-2 (Presentation): Result and discussion and Major findings	**05 Marks**
Total	**10 Marks**

Question Paper Pattern for UG Semester End Examination with effect from the AY 2024-25

(Major Theory Paper)

Paper Code: **Paper Title:**

Time: 3 Hours **Max. Marks: 80**

Instruction: Answer all Sections

SECTION-A

1. Answer the following sub-questions, each sub-question carries **TWO** marks. (05X2=10)

a).

b).

c).

d).

e).

Note for Section-A: One-question from each unit.

SECTION-B

Answer any **SIX** of the following questions, each question carries **FIVE** marks. (6X5=30)

2.

3.

4.

5.

6.

7.

8.

9.

Note for Section-B: Minimum One question from each unit

SECTION-C

Answer any **FOUR** of the following questions, each question carries **TEN** marks. (4X10=40)

8.

9.

10.

11.

12.

13.

Note for Section- C: Minimum one question from each unit. Sub-questions such as ‘a’ and ‘b’ may be given for a question in section-C only.

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Question Paper Pattern for UG Semester End Examination with effect from the AY 2024-25

(Elective Course A1/A2)

Paper Code: **Paper Title:**

Time: 2 Hours **Max. Marks: 40**

Instruction: Answer all Sections

SECTION-A

1. Answer the following sub-questions, each sub-question carries **TWO** marks. (05X2=10)

a).

b).

c).

d).

e).

Note for Section-A: One-question from each unit.

SECTION-B

Answer any **TWO** of the following questions, each question carries **FIVE** marks. (2X5=10)

2.

3.

4.

5.

Note for Section-B: Minimum One question from each unit

SECTION-C

Answer any **TWO** of the following questions, each question carries **TEN** marks. (2X10=20)

6.

7.

8.

9.

Note for Section- C: Sub-questions such as ‘a’ and ‘b’ may be given for a question in section-C only.

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VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI-583 105
B. Sc. …… SEMESTER PRACTICAL
(Major Lab)
SUBJECT - BIOTECHNOLOGY

Paper Code: **Paper Title:**

Time: 3 Hours **Max Marks: 40**

Q. 1. Write a principle, procedure and perform the given experiment….and write a report on result obtained (Major experiment) -10M

Q. 2a. Write procedure and perform Minor experiment-1 -05M

2b. Write procedure and perform Minor experiment-2/ Answer the given problem -05M

Q. 3. Identification (05×02=10M)

3A. Identify & comment
3B. Identify & comment
3C. Identify & comment
3D. Identify & write its significance
3E. Identify & write its significance

Q. 4. Record submission -05M

Q. 5. Viva-voce -05M

SKILL PAPERS

Paper Code: **Paper Title:**

Time: 1.5 Hours **Max. Marks: 40**

There shall be Theory examinations of **Multiple Choice Based Questions [MCQs]with Question Paper of A, B, C and D Series** at the end of each semester for **Skill papers for the duration of 1.5 hour. The Answer Paper is of OMR (Optical Mark Reader) Sheet.**

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