KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

ಸ್ವಾತಂತ್ರ್ಯದ ಅಮೃತ ಮಹೋತ್ಸವ

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NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2024-25/ 1612 Date: 27 JUL 2024

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ಸರಕಾರದ ಆದೇಶ ದಿನಾಂಕ: 08.05.2024 ಅನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳಿಗೆ NEP ಅಡಿಯಲ್ಲಿ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮದ ಅನುಷ್ಠಾನ ಕುರಿತು.

ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಪ್ರಧಾನ ಕಾರ್ಯದರ್ಶಿಗಳು, ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 166 ಯುಎನ್ಇ 2023, ದಿ: 08.05.2024.
2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯಗಳ ಸಂ:2, 3, 4, 5, 6, 7, 8 & 9, ದಿ:16.07.2024.
3. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೊದನೆ ದಿನಾಂಕ: 27/07/2024

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಿಗಳನ್ವಯ, ಉಲ್ಲೇಖ–01ರ ಸರಕಾರ ಆದೇಶಾನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಈ ಕೆಳಗಿನ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳ NEP ಅಡಿಯ ಪ್ರೋಗ್ರಾಂ ವಿನ್ಯಾಸ (Curriculum Structure)ದಂತೆ ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮ ರಚನೆ ಕುರಿತಾಗಿ ಸಂಬಂಧಿಸಿದ ಅಭ್ಯಾಸಸೂಚಿ ಮಂಡಳಿ ಹಾಗೂ ನಿಖಾಯಗಳ ಶಿಫಾರಸ್ಸನಂತೆ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೊದಿತ ಪದವಿಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ ಡೌನಲೋಡ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳು ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತಂದು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕ.ವಿ.ವಿ.ಯ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

ಅ.ನಂ.	ಪದವಿ				ಸೆಮಿಸ್ಟರ್
1	1	B.A	8	BTTM	1 ರಿಂದ 6ನೇ ಸೆಮಿಸ್ಟರ್
	2	BSW	9	B.Sc	
	3	B.Sc. (H.M)	10	BCA	
	4	B.Com	11	B.Com (CS)	
	5	B.Com (E-Commerce Operation)	12	B.Com (Retail Operations)	
	6	B.Com (Banking Financial Services & Insurance)	13	B.Com (Logistics)	
	7	BBA	14	BBA (Logistics Management)	
2	1	B.Sc (Data Science)	2	B.Sc (Artificial Intellgence & Machinery Learning)	1 ಮತ್ತು 2ನೇ ಸೆಮಿಸ್ಟರ್
3	1	BASLP	3	BPA	1 ರಿಂದ 8ನೇ ಸೆಮಿಸ್ಟರ್
	2	BVA	4	B.Sc. Pulp & Paper	

ಕುಲಸಚಿವರು.

ಅಡಕ: ಮೇಲಿನಂತೆ

ಗೆ,
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂರ್ತಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು / ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಔಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ / . ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ನೊಡಲ್ ಅಧಿಕಾರಿಗಳು, ಯು.ಯು.ಸಿ.ಎಂ.ಎಸ್. ಘಟಕ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ಎನ್.ಇ.ಪಿ. ನೊಡಲ್ ಅಧಿಕಾರಿಗಳು, ಸಿ.ಡಿ.ಸಿ. ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

KARNATAK UNIVERSITY, DHARWAD

B.Sc. BIOTECHNOLOGY

SYLLABUS

With Effect from 2024-25

DISCIPLINE SPECIFIC CORE COURSE (DSC) FOR SEM I -VI,

SKILL ENHANCEMENT COURSE (SEC) FOR SEM IV/V/VI and

ELECTIVE COURSES FOR SEM V AND VI

AS PER NEP (Revised): 2024

Karnatak University, Dharwad

B.Sc. in BIOTECHNOLOGY: Effective from 2024-25

Sem.	Type of Course	Theory/ Practical	Course Code	Course Title	Instruction hour/week	Total hours / sem	Duration Of Exam	Marks			Credits
								Forma-tive	Summ-ative	Total	
I	DSC-1	Theory	C1BIT1T1	Fundamentals of Biotechnology	04hrs	60	03hrs	20	80	100	04
	DSC-2	Practical	C1BIT1P1	Fundamentals of Biotechnology	04hrs	56	03hrs	10	40	50	02
II	DSC-3	Theory	C2BIT1T1	Biomolecules and Bioanalytical techniques	04hrs	60	03hrs	20	80	100	04
	DSC-4	Practical	C2BIT1P1	Biomolecules and Bioanalytical techniques	04hrs	56	03hrs	10	40	50	02
III	DSC-5	Theory	C3BIT1T1	Microbiology and Immunology	04hrs	60	03hrs	20	80	100	04
	DSC-6	Practical	C3BIT1P1	Microbiology and Immunology	04hrs	56	03hrs	10	40	50	02
1V	DSC-7	Theory	C4BIT1T1	Molecular biology	04hrs	60	03hrs	20	80	100	04
	DSC-8	Practical	C4BIT1P1	Molecular Biology	04hrs	56	03hrs	10	40	50	02
*V	DSC-9A	Theory	C5BIT2T1	Plant and Animal Biotechnology	04hrs	60	03hrs	20	80	100	04
	DSC-10A	Practical	C5BIT2P1	Plant and Animal Biotechnology	04hrs	56	03hrs	10	40	50	02
	DSC-9B	Theory	C5BIT2T2	Genetic Engineering	04hrs	60	03hrs	20	80	100	04
	DSC-10B	Practical	C5BIT2P2	Genetic Engineering	04hrs	56	03hrs	10	40	50	02
*VI	DSC-11A	Theory-	C6BIT2T1	Industrial and Agriculture Biotechnology	04hrs	60	03hrs	20	80	100	04
	DSC-12A	Practical	C6BIT2P1	Industrial and Agriculture Biotechnology	04hrs	56	03hrs	10	40	50	02
	DSC-11B	Theory-	C6BIT2T2	Environmental and Medical Biotechnology	04hrs	60	03hrs	20	80	100	04
	DSC-12B	Practical	C6BIT2P2	Environmental and Medical Biotechnology	04hrs	56	03hrs	10	40	50	02
V	EC-1	Theory	C5BIT5T1	Biotechnology for human welfare	03hrs	45	03hrs	20	80	100	03
VI	EC-2	Theory	C6BIT5T1	Applications of biotechnology in Food, Dairy and Agriculture	03hrs	45	03hrs	20	80	100	03
IV/V/VI **	Skill	Practical	C0BIT6P1	Immuno techniques	04hrs	56	03hrs	10	40	50	02

*Student shall either DSC 9A and DSC10A or DSC 9B and DSC10B in 5th semester. Similarly, DSC 11A and DSC12A or DSC 11B and DSC12B in 6th semester.

** Student shall study Skill of this subject either in 4th / 5th / 6th but not in all the semester.

Karnatak University, Dharwad
B.Sc. Biotechnology

Programme Specific Outcomes (PSO):

On completion of the 03 years Degree in B.Sc. **Biotechnology** (Basics) students will be able to:

- Demonstrate, solve and understand the major concepts in all the disciplines of Biotechnology.
- Understand practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
- To apply standard methodology to the solutions of problems in Biotechnology
- Provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
- Develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
- Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Biotechnology.
- To build confidence in the candidate to be able to work on his own in industry and institution of higher education.
- To develop an independent and responsible work ethics.

B.Sc. Semester–I

Discipline Specific Course (DSC)-

Course Title: - Fundamentals of Biotechnology

Course Code: C1BIT1T1

Type of Course	Theory /Practical	Credits	Instruction Hours / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-1	**Theory**	**04**	**04hrs.**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of basic structure of cell, its composition and functions
CO2: Understanding of cell differentiation in plant and animals
CO3: Understanding of ageing mechanisms
CO4: Understanding of Genetics and its application in basic biology
CO5: Understanding of Reproductive Biology
CO6: Understanding concepts of Biotechnology

Unit	Title: Fundamentals of Biotechnology (Theory-4, Practical-2)	60 hrs/sem
Unit I	**Chapter No.1: Biotechnology -** A brief introduction, Historical development of Biotechnology, branches of biotechnology. **Chapter No.2: Introduction to living world**– Historical perspective, Cell Theory, Spontaneous generation, Abiogenesis. **Chapter No.3: Ultra structure and function of cells–** Plant and animal cells (Cell wall, Plasma membrane, Mitochondria, Chloroplast, Ribosomes, Gólgi complex. Endoplasmic reticulum. Nucleus, Lysosomes. Peroxisomes, Vacuole, Cytosol and Cytoskeletal structures). Structure of bacteria and virus. Difference between prokaryotic and eukaryotic cell.	15 hrs
Unit II	**Chapter No.4: Chromosomes -** Discovery, Morphology and structural organization; number, size and types, Chromosomal morphology, fine structure and models, heterochromatin and euchromatin, Special chromosomes (Salivary gland and Lampbrush). Linkage and crossing over, Chromosomal variations (autosomal and allosomal disorders), Extrachromosal inheritance (Plastid inheritance in Mirabilis, Petite characters in yeast and Kappa particles in Paramecium). **Chapter No.5: Cell Division in Eukaryotes -** Cell cycle, mitosis and meiosis, mitotic apparatus, centrioles, spindles, cell plate formation, cell synchrony.Cell senescence and programmed cell death. Cell-cell interaction and cancer cells. **Chapter No.6: Gametogenesis -** Spermatogenesis and Oogenesis.	15 hrs
Unit III	**Chapter No.7: Fundamentals of Genetics –**Introduction, History and scope. **Mendelism-** Mendel's work, Laws of heredity, Test-cross, Complete and Incomplete dominance. **Interaction of Genes-** Supplementary factors (Comb pattern in fowls), complementary genes (flower colour in sweet peas), Multiple factor (Skin colour in human beings),	15 hrs

	Epistasis (Plumage colour in poultry). **Mutation-** Spontaneous, Induced-physical and chemical mutagens.	
Unit IV	**Chapter No.8: Introduction of r-DNA technology-** Definition; tools used in rDNA technology. **Chapter No.9: Transgenesis-** Production and significance of transgenic plants (Golden rice) and animals (Sheep). **Chapter No.10: Role of biotechnology in applied fields-** Role of biology in information technology (Bioinformatics), Nanobiotechnology, Sensor (Biosensors), Medical Biotechnology, Biopharmaceuticals and Neutraceuticals.	15hrs

Books recommended:

1. Sudberry P. 2002, Human Molecular cytogenetics. Prentice hall publication
2. Knudson A.G. 1998, Anti–Oncogenes and Human cancer. Proceedings of the National academy of sciences USA 90: 10, 0114 – 10921
3. Lodish, H., Ber, A., Zipursky, L.S., Matsudaira, P., Bahimore, D and Darnell J. 2001, Molecular Biology W. H. Freeman G Co 47
4. Preeti G.2011, Fundamentals of Biotechnology. Galgotia Publications.
5. Sabiha Khan. 2020, Fundamentals of Biotechnology. Lenin Media Pvt. Ltd.
6. FirdosA.K.2020, Biotechnology Fundamentals. Third Edition CRC Press.
7. Bazlur Rashid. M. 2016, Methods in Biotechnology 1st edition Wiley-Blackwell.
8. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., & Watson, J. D. (2008). *Molecular Biology of the Gene* (6th ed.). Garland Publisher Inc.
9. Gerald Karp 2004, Cell and Molecular Biology. John Wiley and Sons. Inc
10. Elliot and Elliot, 2001 Biochemistry and Molecular Biology. Oxford University Press.
11. Celis JE(Eds): 2008 Cell Biology: A Laboratory Hand Book. VolI & II Academic Press.
12. Pollard J.P. and W.C. Earnshow 2002.Cell Biology, Sunders
13. Tamarin, R.H, (2000): Principles of genetics, 6th Edn. WMC Brown Publication. London.
14. Snustad, P. D, Simmons, M. J 2019: Principles of genetics 2nd Edn. John Wiley and sons, Inc. New York.
15. Fairbanks, D. J and Anderson, W. R 1999: Genetics–continuity of life. Brooks and Cole Publication Company. New York.
16. Lewin, B (2020): GENES VII. Oxford University Press, New York.
17. Strick berger, M.W(2000): Genetics Prentice- Hall of India private limited, New Delhi.
18. Miglani G.S 2000 Basic Genetics Narosa publishing New Delhi.
19. E.D.P. and De Robertis E.M.S. 1998: Cell and Molecular Biology, Lea and Jeliger. Philadelphians K.M Varghese Company

Formative Assessment for Theory	
Assessment Occasion / type	**Marks**
Internal Assessment Test 1	05
Internal Assessment Test 2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–I

Discipline Specific Course (DSC)

Course Title - Fundamentals of Biotechnology

Course Code: C1BIT1P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-2	**Practical**	**02**	**04hrs.**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Learning and practicing the laboratory skills in cell biology
CO2: Learning and practicing the laboratory skills in Genetics

List of the Experiments, each will have 04Hrs / Week

1. Study of fixatives- Preparation of formaldehyde (4-10%), Alcohol (70-100%), Bouin's fixative and Carnoy's solution.
2. Study of stains- Borax Carmine (alcoholic), Eosin (alcoholic), Iron (Haematoxylin), Acetocarmine, Aceto-orcein, Schiffs reagent (Feulgen method) and Giemsa's stain.
3. To study mitotic cell division - onion root tips
4. To study meiotic cell division – Grasshopper/ flower bud (Onion or Rhoeo discolor flower)
5. Cell counting methods: Haemocytometer and other aids.
6. To study special chromosomes
7. Study of Barr body by using Buccal epithelial smear
8. Extraction of cellular materials in saline buffers, solvent and precipitation.
9. Isolation of chloroplast from spinach leaves
10. Demonstration of laws of inheritance by using colored beads.
    a) Law of Segregation.
    b) Law of independent assortment.
11. Solve genetic problems
12. Karyotyping of human chromosomes
13. Preparation of permanent slides (Mitosis & Meiosis two from each)
14. Isolation of DNA from different sources.
15. Study of Gene cloning through chart.

B.Sc. Semester– II

Discipline Specific Course (DSC)

Course Title: - Biomolecules and Bioanalytical techniques

Course Code:C2BIT1T1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-3	**Theory**	**04**	**04hrs.**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of basic concepts of chemistry - inorganic and organic compounds and bonding.
CO2: Understanding of Biomolecules, their classification, structure and properties.
CO3: Understanding of Vitamins and their scope and importance
CO4: Understanding of hormones and their role and importance
CO5: Understanding of metabolism and oxidation-reduction reactions
CO6: Understanding of analytical instrumentation and their working principles and applications
CO7: Understanding of DNA, RNA their separation and sequencing techniques

Unit	Title: Biomolecules and Bioanalytical techniques (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Introduction –** Structure and properties of water, pH, biological buffer system, Henderson and Hassel Balch equation. Isotopes and indicators. **Chapter No.2: Carbohydrates**– Introduction, sources, classification, physicochemical properties of important monosaccharides, disaccharides and polysaccharides. Derivatives of carbohydrates. **Chapter No.3: Proteins**– Introduction, sources, classification, structure and properties of amino acids. Concept of Zwitterions, isoelectric points, pKa values. Organization of proteins - Primary, secondary, tertiary and quaternary structures. Stability of proteins. Biological function of proteins. Structural importance of glycoproteins, myoglobin and haemoglobin.	15 hrs
Unit II	**Chapter No.4: Lipids**– Introduction, sources, classification, properties (saponification value, acid value, iodine number, rancidity). Functions of lipids, hydrogenation of fats and oils. Saturated and unsaturated fatty acids. General structure and biological functions of Glycolipids, Phospholipids. Sphingolipids, Lipoproteins, Metabolism-Beta oxidation of fatty acids, biosynthesis of cholesterol. **Chapter No.5: Enzymes**– Introduction, Classification, Properties, factors influencing enzyme catalyzed reactions, coenzymes, co factors, Induced fit theory and lock and key enzyme mechanism, Enzyme inhibition – irreversible and reversible (competitive, non-competitive, and uncompetitive inhibition with an example each). Industrial applications of enzymes.	15 hrs
Unit III	**Chapter No.6: Vitamins** Dietary sources and biological role of vitamins. Water soluble and fat-soluble vitamins. Deficiency manifestation of vitamin A, B, C, D, E and K. **Chapter No.7: Hormones**- Chemistry and functions of pituitary and gonadal hormones. **Chapter No.8: Bioenergetics** Concept office energy transformations. redox potentials. **Chapter No.9: Metabolism –** Glycolysis and Gluconeogenesis**,** Krebs cycle and Electron Transport system.	15 hrs

Unit IV	**Chapter No.10: Bioanalytical tools** A) Microscopy- Compound, Phase contrast, Electron microscope and AFM B) Spectroscopy – Colorimeter, UV- visible spectroscopy -Principle, procedure and applications. C) Centrifugation – Introduction, Principle, Types and applications D) Chromatography – Principle, procedure and application of (Paper, TLC, GC, HPLC and Ion Exchange). E) Electrophoresis – Principle, procedure and Applications (Agarose and SDS-PAGE)	15 hrs

Recommended books:

1 Voet and Voet, Dand, J.G. Voet (2004) Biochemistry, John Wiley and sons.
2 Strayer. L. (2000) Biochemistry, 5th edn. W. H Freeman and company New York.
3 Boyer, R (2002) Concepts in Biochemistry. 2nd edn –Brooks /Cole, Australia.
4 Montgonary, R.M, Conway, T.W-and Spectator, A. A, (1996) Biochemistry-A Case– Oriented Approach 6thedn, Mosby Inc, Missouri.
5 Roa, CNR, (1999) Understanding chemistry, University press Hyderabad.
6 Nelson, D. L., and Cox,M. M. (2001) Biochemistry Mac Milan worth Publishers. Hampshire.
7 Zubey, G. L, Pason, W. W,and Vance, D. E.(1995) Principles of Biochemistry WMC. Brown Publishers, Oxford.
8 Devlin, T. M. (1997) Textbook of Biochemistry with Clinical correlations, Wiley and sons, Inc New York.
9 Garret and Grashem (1999) Biochemistry Saunders College Publishers.
10 Knowler and Leader. The Biochemistry of the nucleic acids.11thednChapman and Hall.
11 Horton, R. Het. al. (1996) principles of Biochemistry. Prentice Hall, International, Inc, New Jersey.
12 William, H. Elliot and Dophince, C. Elliot (3rdedn) Biochemistry and molecular Biology. Oxford Publication.
13 David. E. Metlezer.(2002) Biochemistry Vol1 and Vol2, Elsevier Publication
14 Wilson and Walker (2009) Practical Biochemistry– Principles and techniques, Cambridge University Press, Cambridge, U.K.
15 Chatterjee and Shinde, textbook of medical biochemistry, jaypee Publications
16 Satyanaraya, U. (2021). Biochemistry, 6 e-E books. Elsevier health sciences.
17 Campbell, M.K., Farrell, S. O., and McDouggal, O.M. (2016). Biochemistry. Cengage Learning.
18 Walker. J. M., (2000). Principle and techniques of Practical biochemistry, Cambridge University Press.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–II

Discipline Specific Course (DSC)

Course Title: - Biomolecules and Biochemical techniques

Course Code:C2BIT1P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-4	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Acquiring knowledge about biomolecules, structure and their function
CO2: Understanding of biomolecules and their separation using paper chromatography.
CO3: Apply comprehensive innovation and skills of biomolecules to biotechnology field
CO4: Understanding of enzymes, proteins and their assay methods using colorimeter
CO5: Understanding of assay methods of enzyme amylase, phosphatase, and catalases.

List of the Experiments, each will have 04Hrs / Week

1. Preparation of percent molarity, molality and normality of solution
2. Screening of pH of different samples
3. Preparation of different types of buffers
4. Qualitative analysis of carbohydrates and amino acids.
5. Paper chromatography of amino acids
6. Determination of acid number of an edible oil
7. Determination of Saponification number of edible oil
8. Study of detergent haemolysis in animal cells (Blood of frog and human)
9. Assay of amylase activity.
10. Estimation of proteins by Biuret method.
11. Estimation of reducing sugar/maltose by DNS method.
12. Study of acid phosphatase and alkaline phosphatase activity.
13. Determination of Iodine number of lipids
14. Study of analytical instruments – Colorimeter, Centrifugation, Chromatography, Electrophoresis.

B.Sc. Semester–III

Discipline Specific Course (DSC)

Course Title: - Microbiology and Immunology

Course Code:C3BIT1T1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration ofExam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-5	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of basics of Microbiology and Immunology.
CO2: Understanding of basic laboratory instruments and their working principle
CO3: Understanding of observation, identification, classification, nomenclature of microbes.
CO4: Understanding of microbial, fungal, viral diseases, students learn clinical aspects of infection
CO5: Understanding of microbial media, culturing and growth studies
CO6: Understanding of antigen, antibodies, immunity, immune system and allergic reactions.

Unit	Title: Microbiology and Immunology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Introduction and Scope of Microbiology** - Historical perspectives. Importance and scope of microbiology as a modern science. Branches of microbiology. **Chapter No.2: Microbial techniques** A) Sterilization – Physical and chemical methods of sterilization. B) Staining techniques –Simple, Differential and Structural staining. **Chapter No.3: Ultra structure of bacteria and virus** **Chapter No.4: Microbial taxonomy** Concept of microbial species and strains, (bacteria, fungi, algae, protozoa and virus), types of classification and numerical taxonomy.	15 hrs
Unit II	**Chapter No.6: Culture of microorganisms** Culture media, Types of culture media, Isolation of microorganisms by different methods, Preservation and maintenance of culture. **Chapter No.7: Microbial growth** Nutritional requirements of microorganisms. Bacterial growth curve. Factors affecting growth, Counting of Bacteria. **Chapter No.8: Applied microbial methods -** Quality of air, water and soil sampling methods, food and dairy quality methods (SPC, MBRT, Resazurin test, phosphatase test), biogas production and its advantages, Biomining. **Chapter No.9: Pathogenic microorganisms-** Bacterial diseases- Tetanus, Tuberculosis, Cholera. Fungal diseases – Candidiasis. Viral disease – AIDS (HIV), Covid-19.	15 hrs
Unit III	**Chapter No.10: History and Scope of Immunology** **A) Immunity**- Innate and acquired immunity. Humoral and cell – mediated immunity. **B) Cells of the immune system** Lymphoid cells. B-Lymphocytes, T-lymphocytes and null cells, Mono-nuclear cells -phagocytosis, antimicrobial and cytotoxic activities. Antigen processing cells. Granulocytic cells. Mast cells and Dendritic cells. **C) Organs of the Immune systems** Bone marrow. Thymus, lymph node and spleen.	15 hrs
Unit IV	**Chapter No.11: Antigens -** Types, haptens, epitopes, paratope, role of adjuvants in immunogenicity (Fraud's complete adjuvant and Fraud's incomplete adjuvant), Blood group antigens. **Antibodies** (immunoglobulin's) - structure, types, properties and functions of immunoglobulins.	15hrs

	Chapter No.12: Antigen – Antibody reactions - Mechanism of precipitation, Agglutination, Complement fixation, Mechanism of Immuno-toxin reaction, Immunofluorescence, ELISA and RIA. **Chapter No.13: Hypersensitivity** Types of hypersensitivity – IgE mediated (type – I). Antibody mediated cytotoxic (type-II), Immuno complex mediated (type-III) and T-mediated (type-IV) hypersensitivity reactions.	

Formative Assessment for Theory	
Assessment Occasion / type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– III

Discipline Specific Course (DSC)

Course Title: - Microbiology and Immunology

Course Code:C3BIT1P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-6	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understanding of laboratory skills for inoculation and staining methods.
CO2: Understanding of importance of safety measures in microbiology laboratory, sterilisation Methods and instrument studies
CO3: Understanding of culturing methods and biochemical techniques
CO4: Understanding of RBC and WBC and their counting
CO5: Understanding of various immunological techniques.

List of the Experiments, each will have 04Hrs / Week

1. Safety measures in microbiology laboratory
2. Cleaning, sterilization of glassware and Media Preparation: Nutrient agar, Nutrient broth and potato dextrose agar.
3. Study of instruments: Compound microscope. Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.
4. Isolation of bacteria from air (exposure method), soil and water – by serial dilution methods
5. Isolation of fungi from soil by serial dilution method.
6. Cell size measurement by Micrometry and cell structure by using camera lucida
7. Inoculation techniques: Slant, Stab, Point, Streak, Pour plate and Spread plate
8. Bacterial staining techniques; Simple and differential (Gram's)
9. Antibiotic sensitivity test – Paper method
10. Counting of micro-organisms using Haemocytometer
11. Motility test – Hanging drop method.
12. Biochemical tests - Starch hydrolysis, Catalase and Gelatin liquefaction.
13. Total WBC and RBC count
14. Estimation of hemoglobin content in blood.
15. Diagnosis of infectious disease by Immuno Assay- Widal test for Typhoid and Wassermann test for Syphilis by using kit.

Books recommended:

1. Abbas, A. K. Litchman, A.H and Pober, J.S. 1994: cellular to molecular immunology, 2nd edition W.B Saunders Company, New York Charles
2. Ananthanarayan R. Jayarman Paniker 2005: Textbook of Microbiology Longman publication
3. Aneja K R 2000: Experimental in Microbiology Plant and Tissue culture. New age International. New Delhi.

4. Atlas R. M 1998: Microbiology, Fundamentals and application 2nd McMillan publishing Co. New York
5. Auro, P.T Kapoor, K.K. Yadav, KS 1996: An introduction to Microbiology, New Age International Pvt. Ltd.
6. Cobman, R. M. Lambard, M. F. And Sieard, R. F. 1992: Fundamental of immunology. 2ndEdn W.C. Brown Publishing.
7. Eli Benjamin, Richard Coiro, Geoffery Sunshine. 1992: immunology, 2ndedn, William and William Baltimore.
8. Gerhot, p. Murry, R. G. Wood W. A and Kreig, N. R 1994: Methods for general and molecular bacteriology American Society for Microbiology Washington DC.
9. Holt, J, S. Kreig, N. R. Sneaik P. H. A and Williams, S. T 1994: Berge's Manual of systematic bacteriology. 9th edition. Williams and Williams Baltimore.
10. Ivan M. Roitt 1994: Immunology, Black Welll Scientific Publication. London.
11. Janeway, Paul Travers, 2001: Immunology, Garland Publishing, New York.
12. Joshi K.R and Osama, N.O 1998: Immunology Agro BotonicaBikoner.
13. Klaus D. Elgert 1996: Immunology – Understanding of immune system. Wiley liss New York
14. Kuby Immunology 9th edn. 2018
15. Kumar, H. D and Swati Kumar 1998: Modern concepts of Microbiology. Vikas Publishing House Pvt, Ltd, NewDelhi
16. Mayforth, R.D 1993: Designing antibodies. Academic Press New York
17. Osborne 2000:
18. Pelezar, chan, krieg, 2003: Microbiology – Tata McGraw Hill Publications
19. Prescott, I. M. Harley, J.P and Klien, D. A 1996: Microbiology WMC Brown Publishers.
20. Purohit, S.S 2000: Microbiology, Agrobois ◦ Sharma P. D 2001: Microbiology, Rastogi Publications, Meerut
21. Richard Goldaby, Thomas, J. Kindt Barbara, A. immunobiology, W.H.Freeman Company, New York.
22. Stainer,R. Y. Ingraham, J.l. Wheelis, M.L and Painter, P.R 1992: General Microbiology, McMillon Publishing Ltd. London
23. Sundarrajan, S 1999: College Microbiology, Vardhan Publishing, Bangalore,
24. William, E. Paul 1989: fundamental immunology, 2nd Edition Raven Press, New York.

B.Sc. Semester–IV

Discipline Specific Course (DSC)

Course Title: - Molecular biology

Course Code:C4BIT1T1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-7	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of origination of molecular basis of life, DNA and RNA.
CO2: Understanding of basic cellular processes - transcription, translation, DNA replication and repair mechanism.
CO3: Understanding of structure, functional relationship of proteins and nucleic acids
CO4: Understanding of recombination in prokaryotes and genetic code.
CO5: Understanding of gene expression and regulation in prokaryotes and eukaryotes.
CO6: Understanding of Genome organization in prokaryotes and eukaryotes.

Unit	Title: Molecular biology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Molecular basis of life**- Introduction, Experimental proof of DNA and RNA as genetic material. **Chapter No.2: Nucleic acids**- Structure, types and function of DNA and RNA. Ribozymes. Watson and Crick model of DNA and other forms of DNA (A and Z).	15 hrs
Unit II	**Chapter No.3: DNA replication**- Prokaryotic and Eukaryotic – Enzymes and proteins involved in replication. Theta model and Rolling circle model. **Chapter No.4: DNA damage and repair** - Causes and mechanisms - Photo reactivation, Excision repair, Mismatch repair and SOS repair.	15 hrs
Unit III	**Chapter No.5: Recombination in prokaryotes** - Transformation, Conjugation and Transduction **Chapter No.6: Structure of prokaryotic and Eukaryotic gene**- Genetic code, properties and deciphering. **Chapter No.7: Transcription** - Process of transcription, transcription factors, post transcription modification. **Chapter No.8: Translation** - Initiation, elongation and termination of protein synthesis, translational factors. Post translational modification of protein.	15 hrs
Unit IV	**Chapter No.9: Gene Expression and Regulation** - Gene Expression and Regulation in Prokaryotes – Operon concept (Lac operon model). **Chapter No.10: Gene Expression and Regulation in Eukaryotes** -Transcriptional activation, galactose metabolism in yeast. **Chapter No.11: Gene organization and expression**- Mitochondria and chloroplasts. **Chapter No.12: Insertional elements and transposons**- Introduction, types of Transposable Elements - Maize and Drosophila.	15hrs

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV

Discipline Specific Course (DSC)

Course Title: - Molecular biology

Course Code:C4BIT1P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-8	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of basic of DNA and RNA structure and its model
CO2: Understanding of DNA and RNA estimations
CO3: Understanding of protein extraction and estimation by standard analytical methods
CO4: Understanding of Protein separation by PAGE method
CO5: Understanding of Recombination in prokaryotes
CO6: Understanding of mutations

List of the Experiments, each will have 04Hrs / Week

1. Preparation of DNA model.
2. Estimation of RNA by Orcinol method.
3. Estimation of DNA by DPA method
4. Determination of Tm value and purity of DNA.
5. Extraction and estimation of protein from animal source (Milk /egg / goat liver) by salt precipitation and organic solvent method.
6. Extraction and estimation of protein from plant source (Green gram/pea) by salt precipitation and organic solvent method
7. Protein separation by polyacrylamide gel electrophoresis.
8. Demonstration of conjugation, transformation and transduction by charts.
9. Isolation of UV induced mutants of *E.coli*
10. Demonstration of petite characteristics in yeast upon UV exposure
11. Demonstration of Drosophila mutants
12. Isolation of DNA from bacterial cells
13. Transformation study by kits.

Books recommended:

1. Lodish, H., Ber, A., Zipursky, L.S., matsudaira, P., bahimore, D and Darnell J. 2001, Molecular Biology W.H. Freeman De Robertis.
2. E.D.P. and De Robertis E.M.S. 1998: Cell and Molecular Biology, Lea and Jeliger. Philadelphians K.M Varghese Company
3. Freifelder, D. And Malacinski, G.M. 1993: Essentials of molecular biology, jones and Barklett Publishers, Inc
4. George, M. And Malacinski 1998: Essentials of molecular biology, jones and Barklett Publishers, Inc
5. Glick, B, R and Pasternak j. J 2000: Molecular Biotechnology, principle and

applications of recombinant DNA. American society for Microbiology. Washington DC

6. Griffiths, A. J. F. Miller, J.H. Suzuki, D.T. Lewontic, R.C. Gilbert W.M 2000. An introduction to genetic analysis. 7th edn W. H. Freeman. New York

7. Gene cloning and manipulation, Cambridge University Press. Howe. C.1995. USA

8. Karp, G 1996: Cell and Molecular Biology Concept and Experiments. John Wilcy and Sons Inc. New

9. Roger L.P. Adams, John Knowlwe and david P. Lender 2000: Biochemistry of Nucleic acid. Chapman and Hall publications

10. Sandya Mitra 1988: Elements of molecular Biology. Mcmillan Publications,

11. Smith 1998: Molecular Biology. Faber and Faber publication

12. Watson J.D. Hopkins, N.H. Roberts J.W. Steitz. J.A and weiner A.M 1987: Molecular Biology of Gene 4th Edn Benzamin Publ. Co. New York,

B.Sc. Semester–V

Discipline Specific Course (DSC)

Student shall select DSC 9A & 10 A or 9B & 10 B for 06 credits only

Course Title: - Plant and Animal Biotechnology

Course Code:C5BIT2T1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-9A	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of history and development of plant biotechnology
CO2: Understanding of composition and preparation of different plant growth media
CO3: Understanding of techniques in micropropagation,
CO4: Understanding of types of animal cell and tissue culturing methods.
CO5: Understanding of scope of animal biotechnology
CO6: Understanding of transgenic animals and IPR

Unit	Title: Plant and Animal Biotechnology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Plant Biotechnology -** History and development of plant biotechnology. *In vitro* culture methods and laboratory facilities. **Chapter No.2: Growth medium composition -** Use of growth regulators and their effect on cell growth, Study of M.S., B5 and Nitsch media. **Chapter No.3: Plant Tissue Culture – A) Callus differentiation.** Regeneration of shoots and root. Organogenesis, Embryogenesis, Embryo culture, ovary and endosperm culture. Cell suspension and single cell clones. **B) Micro propagation**. Clonal propagation of elite species, auxillary bud. Shoot tip and meristem culture. Applications of micro propagation. **C) Plant Tissue culture Applications-** In agriculture, horticulture and cryopreservation	15 hrs

Unit II	**Chapter No.4: Animal Biotechnology:** Historical perspectives, development and scope. **A) Basic techniques of animal cell culture**- Preparation and sterilization of glasswares and apparatus, preparation and sterilization of reagents and media, preparation of animal material and applications. **B)Animal tissue culture media -** Culture media containing naturally occurring ingredients. Blood plasma, blood serum, serum free media, tissue extracts, complex natural media, chemically defined media. **C) Primary culture, cell lines and cloning -** Primary and established cell lines, somatic cell fusion, tissue cultures, whole embryo culture example chick embryo.	15 hrs
Unit III	**Chapter No.5: Genetic engineering -A) Introduction, Tools of genetic engineering.** **B)Enzymes**- Restriction endonucleases: Classification, nomenclature, types and their application in recombinant DNA technology. Ligases: DNA ligases and their application, enzymes to modify ends of DNA molecules. **C)Vectors/Vehicle DNA:** Plasmid and their features, some common plasmid vectors- pBR 332, pUC 18.	15 hrs
Unit IV	**Chapter No.6: Gene cloning:** Methods of introducing gene in prokaryotes and eukaryotes (*E.coli* and yeast cells as cloning host). Detection of the right clone, Direct screening, direct selection, indirect screening technique, nucleic acid probes, hybridization technique. immunodiagnostic probe. Cells for cloning: *E.coli*, strains used for cloning, expression of cloned DNA in *E.coli* **Chapter No.7: A) Genetically Modified Technology for nutrition and food security:** Tomato, strawberry, pumpkin, Sweet Paper, veterinary products, chocolates, cheese, **B) Transgenic animals-**Transgenic mice and sheep.	15 hrs

Recommended books:

1. Bhan1998. 'Tissue culture", Mittal publication. NewDelhi.
2. Chatwal.G.R.1995: Text Book of Biotechnology, Anmol Publ. Pvt. Ltd.
3. Crueger. W. and Crueger. A.: Biotechnology A text book of Industrial Microbiology. 2nd Ed.
4. GamborgandPhillips.1996PlantCell, Tissue and Organ Culture:Fundamental methods.NarosaPubl,
5. GuptaP.K.1996: Elements of biotechnology; Rastogi and Company.
6. Harrison,Maureen,A., Rac.Ian.F.1997:GeneralTechniqueofcellcultureCambridge UniversityPress.
7. Ignacimuthu, S.1996: Applied Plant Biotechnology.
8. Lyeliane Kyte and Jhon Kleyn, 1996. Plants from test tubes - An Introduction to Micro propagation III edition, Timber press Portland.
9. Narayanaswamy, S.1994: Plant Cell and tissue Culture. New Delhi. TataMcGrawHillPublishingCompany.
10. Prakash.M.and Arora,.G. K.1998: Cell and Tissue Culture, NewDelhi, Anmol Publication.
11. Razdan.M.K.1993: An introduction toPlant Biotechnology.
12. Shrivastava P.S. "Plant Tissue culture and molecular Biology; applications and prospects, Narosa publishing house, New Delhi.

13. Cartwnzht, T. 1994: Animal Cells as Bioreactors, Cambridge University Press, New York.
14. Freshney; R. L. 1987: Culture of animal cells: Amanual of basic techniques.
15. Ian, R.. Fresheney:Wiley-Liss(3rd edn.) Culture of Animal Cells.
16. John. R. W.: Animal Cell culture -Practical approach Marters, Oxford.
17. Puhler. A. 1993: Genetic Engineering of Animals. VCH Publishers, Weinheim FRG
18. Ravi Shankar, G.A. and Venkataram, L.V.1997: Recent Advances in Biotechnology. Application of Plant Tissue and Cell Culture. New Delhi, Oxford and IBH Publishing Company.
19. SateeshM.K.2003.Biotechnology-5. New age international publishers.
20. Spier, R.E. and Griffith,T.B.1987:Modern approaches to Animal Cell Technology, Somerset, Butterworth and Company Ltd.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Course (DSC)

Course Title: - Plant and Animal Biotechnology

Course Code:C5BIT2P1

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-10A	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of preparation of plant tissue culture media.
CO2: Understanding of callus induction, seed culture and demonstration.
CO3: Understanding of protoplast isolation and fusion
CO4: Understanding of preparation of synthetic seeds
CO5: Understanding of extraction of mammalian and chicken serum
CO6: Understanding of culturing of chick embryonic cells
CO7: Understanding of Genetic Engineering tools.

List of the Experiments, each will have 04Hrs / Week

1. Preparation of plant tissue culture media.
    a) MS.
    b) B_5
    c) LS
2. Callus induction using plant explants (Carrot, Nicotine and sugarcane).
3. Seed Culture.
4. Demonstration of organogenesis
5. Demonstration of micropropagation.
6. Demonstration of anther culture
7. Protoplast isolation from mesophyll cells.
8. Suspension cultures: Initiation of suspension culture from callus.
9. Preparation of synthetic seeds.
10. Cell viability test using Trypan blue exclusion method.
11. Preparation of balanced salt solutions:(Hank and Earl).
12. Extraction of serum (Chicken/mammalian).
13. Study of instruments for animal cell culture – inverted microscope, biosafety cabinet, CO_2 incubator
14. Isolation of plasmid from bacteria
15. Photographic demonstration of transgenic crop plants/animals in biotechnology innovations.
16. Isolation of RNA from different sources.

B.Sc. Semester–V

Discipline Specific Course (DSC)

Student shall select DSC 9B & 10 B or DSC 9A & 10 A for 06 credits only

Course Title: - Genetic Engineering

Course Code:C5BIT2T2

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9B	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of fundamental principles and techniques of Genetic Engineering
CO2: Understanding of genetic engineering in agriculture, medicine and environmental studies
CO3: Understanding and developing practical skills in genetic engineering
CO4: Understanding and implying ethical, social and legal implications of genetic engineering
CO5: Understanding of importance of human genome project
CO6: Understanding of rules and regulation of handling genetically modified organisms

Unit	Title: Genetic Engineering (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Genetic engineering:** Introduction, Tools of genetic engineering. **Chapter No.2: Enzymes**- Restriction endonucleases: Classification, nomenclature, types and their application in recombinant DNA technology. Ligases: DNA ligases and their application, enzymes to modify ends of DNA molecules. **Chapter No.3: Vectors/Vehicle DNA:** Plasmid and their features, some common plasmid vectors-PBR 322, pUC 18.	15 hrs
Unit II	**Chapter No.4: Gene cloning:** Methods of introducing gene in prokaryotes and eukaryotes (*E.coli* and yeast cells as cloning host). **Chapter No.5:** Detection of the right clone, Direct screening, direct selection, indirect screening technique, nucleic acid probes, hybridization technique. immunodiagnostic probe. **Chapter No.6:** Cells for cloning: *E.coli*, strains used for cloning, expression of cloned DNA in *E.coli*	15 hrs
Unit III	**Chapter No.7: Gene libraries -** Genomic library and cDNA library. **Chapter No.8: DNA Mapping -** Restriction mapping and applications. **Chapter No.9: DNAsequencing -**Outline of Maxam-Gilbert's method and Sanger's dideoxy method, Next Generation Sequencing, CRISPR-9 **Chapter No.10: Bioinformatics** – Introduction, Role of Bioinformatic tools in genetic engineering.	15 hrs

Unit IV	**Chapter No.11: Applications of rDNA technologyin human health** - Production of recombinant vaccines - Hepatitis B. Production of insulin. Human genome project and its implication. **Chapter No.12: Biosafety -** Rules and regulations of handling genetically modified organisms **Chapter No.13: Biotechnology and intellectual property rights (IPR) -** Patents, trade secrets, copy right and choice of IPR.	15hrs

Recommended books:

1. Benjamin Lewin,"Genes I, Wiley Eastern Ltd., Delhi.
2. Benjamin Lewin, "Genes-II, Genes III, Wiley and sons publications.
3. Benjamin Lewin, Genes-V &VI Oxford University press.
4. Brown, T.A.1998: Genetics: A molecular approach3rd edn. Stanley Thornes (Publishers) Ltd. United Kingdom.
5. Chiristopher H. 1995"Gene cloning and Manipulation",Cambridge University Press.
6. Davis, R.W. Boterin, D.and Roth, J.R. 1980: A manual for genetic engineering, cold spring harbor laboratory. Cold Spring Harbor. New York.
7. Gardner. Simmons. Snustad1991: Principles of genetics.8th edn. John Wiley and Sons. Inc.
8. Mitchell, D.S.T.1994: An introduction to genetic Engineering. Cambridge University Press.
9. Old and Primrose, “Principles of gene Manipulation", Blackwell Scientific publications.
10. Peters.P.1993: A guide to genetic engineering. Dubuque, Lowa. WMC Brown.
11. Rigbu ,P. W. J.1987:Genetic Engineering 6, Academic Press Inc .Florida, USA.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as pe rguidelines.	

B.Sc. Semester– V

Discipline Specific Course (DSC)

Course Title: - Genetic Engineering
Course Code:C5BIT2P2

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10B	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Acquire knowledge on instruments used for genetic engineering
CO2: learning and practicing laboratory skills for genetic engineering
CO3: learning techniques related to nucleic acid extraction
CO4: learning techniques of gel electrophoresis and PCR
CO5: Understanding of DNA fingerprinting, Gene cloning

List of the Experiments, each will have 04Hrs / Week

1. Isolation/Extraction of genomic DNA from bacteria and yeast.
2. Isolation /Extraction of genomic DNA from plant and animal tissues.
3. Study of denaturation and renaturation of DNA.
4. Quantification of extracted DNA by spectrophotometer.
5. Agarose gel electrophoresis of DNA.
6. Isolation of RNA from plant.
7. Isolation of RNA from animal tissues.
8. Isolation of protoplast from bacteria/plants / animals
9. DNA fingerprinting: Comparison of two plates of monomorphic and dimorphic hands (Demonstration).
10. Study of gene cloning using charts.
11. Study of principles of genetic engineering equipments.
12. Demonstration of designing of probes using softwares
13. Demonstration of Restriction digestion of DNA and ligation

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B.Sc. Semester–VI

Discipline Specific Course (DSC)

Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title: -Industrial and Agriculture Biotechnology
Course Code:C6BIT2T1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-11A	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understanding of significance of upstream and downstream processing.
CO2: Understanding of Microbial products.
CO3: Understanding of crop improvement and breeding techniques.
CO4: Understanding of plant tissue culture and its applications
CO5: Understanding of biofertilizers, plant growth promoters.
CO6: Understanding of transgenic plants and plant breeding techniques.

Unit	Title: Industrial and Agriculture Biotechnology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1: Introduction to Industrial biotechnology**, Basic principles of fermentation technology. **Chapter No.2: Screening** –primary and secondary methods for screening of antibiotics, organic acids and enzymes. **Chapter No.3:A)Bioreactors-** Typical fermentor, types of fermentor (Principle and applications). **B) Principle of upstream processing-** Inoculum preparation, fermentation media, sterilization techniques in fermentation plant. **C) Scale up-** Fermentation pilot plant studies **D)Types of microbial cultures-** Batch culture and continuous culture **E)Downstream processing-** Cell disruption, solid-liquid separation (Filtration, centrifugation), extraction (liquid-liquid extraction) concentration (distillation, crystallization) purification (chromatography, precipitation, dialysis) of products. Drying devices- lyophilisation and spray dry technology.	15 hrs
Unit II	**Chapter No.4:A)** Production of microbial products: Lactic acid. Alcohol, Penicillin and amylase. **B) Fermented Food -** Yoghurt, Buttermilk, Dosa, Cheese, Tempeh. **C) Microbial Foods -** Single cell protein (SCP), Single cell oils (SCO). Mass culture of algae (Spirulina). **D) Plant cell suspension culture for the production of food additives-** Saffron and Capsaicin and shikonin. **E) Microbial polysaccharides and polyesters-** Production of xanthan gum and polyhydroxy alkanoates (PHA).	

Unit III	**Chapter No.5 Introduction to agricultural biotechnology.** **A)** Crop improvement, hybridization and plant breeding techniques. **B)** Plant tissue culture applications in agriculture, horticulture and cryopreservation. **C)** Study of biopesticides used in agriculture (Neem as example). **D)** Integrated pest management. **E)** Mechanism of biological nitrogen fixation process, study of nif. nod and Hup genes in nitrogen fixation process. **F)** Biofertilizers. Mechanism of growth promotion by microbial inoculants - Rhizobium. Brady rhizobium, Azospirillum, Azotobacter and Mycorrhizae	
Unit IV	**Chapter No.6** **A)** Use of plant growth regulators in Agriculture and Horticulture. **B)** Transgenic plants: Techniques and application (BT cotton) **C)** Application of genetics in animal breeding **D)** Breeding selected traits into livestock- Breeding with markers of genetic diseases. **E)** Application of biotechnology in Apiculture and Sericulture.	Unit III

Books recommended:

INDUSTRIALBIOTECHNOLOGY:

1. Casida, L E.1968: Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
2. Dubey, A. R. C.1995: A Textbook of Biotechnology.
3. GlazerA. N and Nikaido, H-1995:"MicrobialBiotechnologyW.H. Freeman and Co.
4. Harrison, Maureen, A., Ral, Ian, F. 1997: General Techniques of cell culture, Cambridge University Press.
5. JayJames, M-1996: Modern food Microbiology CBS Publishers, New Delhi.
6. Mallik, V.S.and Sridhar, P.1992: Industrial Biotechnology.
7. Patel,A. H.1984: Industrial Microbiology.
8. Prakash.M. and Arora,C. K.1998:CellandTissueCulture,NewDelhi. Anmol Publications.
9. Prescott, S.C.and Dunn, C.1984; Industrial Microbiology, McGrawHill. NewYork.
10. Purohit.S.S.and Mathur,S. K.1996:Biotechnology-Fundamentals and applications Agro botanical Publishers, New Delhi.
11. Purohit.S.S., Mathur.S.K.1996: Biotechnology–fundamentals and application. Agrobotanical Publishers. New Delhi.
12. Singh.B.D.2000: Biotechnology. Kalyani publishers. Ludhiana
13. Spier, R. E. and Griffith J. B.1987: Modern approaches to animal cell technology. Somerset, Butter worth and Company Ltd.
14. Stanbury P. F., Whitaker H. T. Hall S. J. 1997:"Principle of Fermentation Technology" Aditya book limited.
15. Sullia S. B. and Shantharam S.1998:"General microbiology "Oxford and IBM publishing Co. Pvt.
16. Wulf Crueger and Annelier: Biotechnology. Atext book of Industrial Microbiology. Crueger- Panima Publishing Corporation. New Delhi.

AGRICULTURE BIOTECHNOLOGY:

1. Chatwal.G.R.1995: Text Book of Biotechnology. Anmol Publ. Pvt. Ltd.
2. ChrispeelM.J.andSdavaD.E.1994. Plants, Genes and Agriculture. Jones and Barlett Publishers Boston.
3. Crueger. W.and Crueger. A.: Biotechnology-A textbook of Industrial Mcirobiology ,2nd edn.
4. Gamborg and Phillips 1996: Plant Cell. Tissue and Organ Culture: Fundamental methods. Narosa Publ.
5. Gupta.P.K.1996: Elements of Biotechnology, Rastogi and Company.
6. Ignacimuthu, S.1996: Applied Plant Biotechnology.
7. Natesh, S. Chopra, V. L. and Ramachandran. S. 1994 "Biotechnology in Agriculture"Oxford and IBM Publ. Co. Pvt. Ltd. New Delhi.
8. Prakash.M.andArora.C.K.1998: Cell and Tissue Culture. New Delhi. Anmol Publication.
9. Razdan.M.K. 1993: An introductionto Plant Biotechnology.
10. Singh, B. D.2000: Biotechnology, Kalyani Publishers. Ludhiana.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Course Title: - Industrial and Agriculture Biotechnology
Course Code:C6BIT2P1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-12A	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understanding of learning and practical approaches of fermenters and their types .
CO2: Understanding of importance of fermentation technology in bio pharmaceutical Industry.
CO6: Understanding of importance of biofertilisers and vermicomposting.
CO1: Understanding of soil microorganisms and interaction with plants.
CO2: Understanding of soil pH, alkalinity, organic content etc.
CO3: Understanding of biopesticides in pest control.
CO4: Understanding of of biocontrolling agents and biofertilisers.

List of the Experiments, each will have 04 Hrs / Week

1. Isolation and identification of industrially important microorganisms
2. Isolation of industrially important microorganisms from natural resources (Spirulina, Agaricus, Yeast and Aspergillus, Lactobacillus).
3. Study of sugar fermentation by microorganisms by acid and gas production.
4. Bacteriological examination of water by MPN method.
5. Preparation of wine from; Grape, Banana/sweet potato, estimation of the percentage of alcohol, total acidity and volatile acidity in wine.
6. Culturing of Microorganisms from vermicomposting.
7. Calculation of thermal death point of a microbial sample
8. Isolation of phages by sewage sample
9. Study of life cycle of Honey bee and Silkworm.
10. Isolation of soil microorganisms- *Rhizobium, Azotobacter and Mycorrhizae*.
11. Estimation of soil alkalinity and organic matter.
12. Effect of bio-pesticides on the growth of microorganisms.
13. Seed inoculation with *Rhizobium* culture and observation for root nodulation.
14. Study of R:S ratio (Rhizosphere: Non-rhizosphere samples).
15. Visit to research centers/institutions/Industries.

Note: A report on the visit should be submitted along with Practical record.

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Student shall select DSC 11B & 12 B or DSC 11A & 12A for 06 credits only

Course Title: -Environmental and Medical Biotechnology
Course Code:C6BIT2T2

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-11B	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of Antibiotics and chemotherapy
CO2: Understanding of Hybridoma technology and its applications.
CO3: Understanding of Biofarming, Bioinformatics and Nanotechnology
CO4: Understanding of importance of Environmental Biotechnology through case studies, research findings and real world applications.
CO5: Understand and evaluate sustainable approaches of Environmental Biotechnology practices
CO6: Understanding of xenobiotic compounds and bioremediation
CO7: Understanding of Environmental Protection Act and related issues
CO8: Understanding of environmental pollution, green house effect, acid rain, global warming and its protection.

Unit	Title: Environmental and Medical Biotechnology (Credits: Theory-4, Practicals-2)	60 hrs/ sem
Unit I	**Chapter No.1 Environmental Biotechnology** **A)** Pollution- Study of Air, water, and Soil pollution. **B)** Renewable and non-renewable resources of energy. **C)** Impact of Conventional and non-conventional fuels on the environment **D)**Biodegradation (xenobiotic compounds - simple, aromatic and petroleum products) and Bioremediation. **E)** Solid waste management - Biogas production and its advantage.	15 hrs
Unit II	**Chapter No.2** **A)** Microbial ore leaching and recovery - Biomining. **B)** Treatment of municipal waste and industrial effluents. **C)** Study of Vermi composting. **D)** Environmental protection Act and related issues. **E)** Concept of global warming, ozone depletion (Green house effect, acid rain and ecofarming	15 hrs
	Chapter No.3 Introduction and scope of medical biotechnology. A) Antibiotics and chemotherapy B) Antimicrobial agents, classification of Antibiotics- Penicillins and Cephalosporins,	15 hrs

Unit III	Broad spectrum antibiotics, antibiotics mode of action, Antifungal agents. Vaccines C) Production of Bacterial and viral vaccines, recombinant vaccines and its production, Foot and Mouth Disease Virus (FMDV) gene vaccines. D) Enzymes used in diagnosis- Immobilized enzymes. E) Enzymes in Therapy- Important enzymes and their therapeutic applications. Eg- Adenosine deaminase F) Therapeutic proteins- Important proteins and their applications in therapy - Somatostatin. Cytokines. Interleukin, Interferon, Human factor-VIII and IX.	
Unit IV	**Chapter No. 4 Hybridoma Technology** A) Production of monoclonal antibodies and their applications. B) Human gene therapy C) Somatic and germ line therapy, in vivo and in vitro gene therapy with an example each, scope of human gene therapy, stem cell therapy. D) Antisense Technology: Principles and applications. E) Biofarming: Production of biopharmaceuticals in plants and animal tissues.	15hrs

Books recommended:

ENVIRONMENTALBIOTECHNOLOGY:

1. A. K. D. E.: Environmental Chemistry. Wiley Eastern Ltd., New Delhi
2. Agrawal, K. C.1996: Biodiversity, Agro-botanical publishers. NewDelhi.
3. Alexander N. Glazer Hiroshi Nikaido,1995"Microbial biotechnology, Freeman and company.
4. Allsopp D. and Seal. K. J .: Introduction to Biodeterioration, EL85/Edward Arnold.
5. Baker, K.H. and Herson, D. S. 1994: Bioremediation McGraw Hill Inc., New York.
6. Chatterji A.K.2002,"Introduction to Environmental Biotechnology", Prentice Hall of India, New Delhi.
7. Christon, J., Harst 1997: Manual of Environmental Microbiology, ASM Press, Washington, DC.
8. D.P. Singh, and S.K. Dwivedi,"Environmental Microbiology and Biotechnology, New Age International publishers.
9. Dicastri. F. and Younes, T. 1996: Biodiversity Science and development CAB international, Walfing fords U.K.
10. Foster C. F. Johnwae D.A. "Environmental Biotechnology"Ellis Horwood limited.
11. Grabiel Baston 1994: Waste Water Microbiology. Willey-Liss Inc., NewYork.
12. Lehniger, T. et. al. : Microbiology Degradation of Xenobiotics and Recalcitrant Compounds, Academic Press. New York.
13. Metcalt and Eaddy Inc. Waste Water Engineering- Treatment Disposal and Reuse.Tata McGraw Hill. Delhi.
14. Mitchell.R.: Water Pollution Microbiology Vol. I and II Wiley inter science. New York.
15. Sinha.R.K.1997: Global biodiversity. INA. Shree Publishers. Jaipur.

MEDICAL BIOTECHNOLOGY

1. Strokes, J., *et al*. 1993 Clinical microbiology– 7thEdn
2. Colle, J. G., 1989. Practical Medical microbiology, Churchill livingstone
3. Anathnarayana, R., andC .K. Jayarampaniker.1997.Text Book of Microbiology, Orient Longman.
4. Jawetz, E., Melonick, J.L., Adelberg, E.A. 1987: Review of Medical microbiology, Prentice Hall,.

5. Mackie and McCarthy1996.Medical microbiology, Vol-I,Microbial infectionVol-II,Practical Medical microbiology, churchil livingstone.
6. Nester, Roberts, Pearsall,Anderson.1998.Microbiology–a human perspective, 2nd edn, McGraw-Hill.
7. Warren, Levinson.2000. Medical microbiology and immunology: Examination and Board review. 8th edn, McGraw Hill.
8. Credric, A. mims 2004. Medical microbiology–3rd edn. Moshy Inc.
9. Lesliccollier, john oxford.2000. Human virology:A text book for students of medicine, dentistry and microbiology2ndEdn, Oxford university Press
10. Topley and Wilson. Principles of Bacteriology, Virology and Immunity, Edward Arnold.
11. Hoghl and Mottet. Clinical microbiology,J. b. Lippincott Company.
12. Kenneth, J. R. Medical microbiology –introduction to infectious diseases, printice Hall Int.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessmen tTest2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course (DSC)

Course Title: - Environmental and Medical Biotechnology
Course Code:C6BIT2P2

Type of Course	Theory /Practical	Credits	Instruction Hour / Week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
DSC-12B	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understanding of antibiotic sensitivity and disease diagnosis using PCR
CO2: Understanding of life cycle of Honey bee and Silkworm
CO3: Understanding of methods and testing of potability of water
CO4: Understanding of various advancements in sewage treatment
CO5: Understanding of techniques for studying pollution in the environment

List of the Experiments, each will have 04Hrs / Week

1. Analysis of water samples for BOD, O_2 and microbial flora.
2. Demonstration of sewage treatment plants
3. Study of Biogas plant.
4. Analysis of TDS from effluents.
5. Estimation of total suspended solids of effluents.
6. Microbial degradation of cellulose.
7. Culturing of antibiotic resistant strains of bacteria and verification for resistance.
8. Antibiotic sensitivity test- Well method.
9. Demonstration of PCR for diagnosis of a disease.
10. Study of Antisense technology through chart/scheme writing
11. Effect of high salt concentration on microbial growth.
12. Oligodynamic action of heavy metals on microbes.
13. Determination of COD

B.Sc. Semester– V

Elective Course (EC-1)
It is for other combination students

Course Title: - Biotechnology for human welfare
Course Code:C5BIT5T1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-1	**Theory**	**03**	**04**	**45hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding of role of biotechnology in production fermented foods and other products
CO2: Understanding of role of biotechnology in forensic science
CO3: Understanding of role of biotechnology in human health management
CO4: Understanding of significance of reproductive biotechnology

Unit	**Title: Biotechnology for human welfare**	45 hrs/ sem
Unit I	**Chapter No.1: In industry -** Industrial production of fermented foods (yoghurt, cheese, dosa, butter milk, tempeh), alcohol, enzyme, organic acids, pigments, dyes, SCP, antibiotics. **Chapter No.2: In environments -**Biogas production, Vermicompost, Biofertilizers, mushroom cultivation, floriculture, Apiculture, Seribiotechnology. **Chapter No.3: A) Waste management -** Treatment of municipal waste and industrial effluents. **B) Bioremediation -** Bioremediation of xenobiotic compounds.	15 hrs
Unit II	**Chapter No.4: Biotechnology in forensic science -**DNA finger printing, Solving crimes such as murder and rape; solving claims of paternity and theft etc. using various methods.	15 hrs
Unit III	**Chapter No.5: Health**- Biopharmaceuticals, development of non-toxic therapeutic agents, recombinant vaccines, insulin, gene therapy, molecular diagnostics using ELISA, PCR, monoclonal antibodies and their use in diagnostics and therapy, human genome project **Chapter No.6: Reproductive Biotechnology** -*In vitro* fertilization, IUI, nuclear transfer, embryo Transfer	15 hrs

Books recommended:

1. H.K. Dass (2018) Text of Biotechnology., Wiley India publication
2. B.D. Singh (2017) Biotechnology new horizon., Kalyani publishers
3. R.C. Dubey (2015) Text of Biotechnology, S. Chand and company
4. U. Satyanarayan (2005) Biotechnology. Books & Allied (P) LTD.-Kolkata

5. W.T. Godbey (2014) An Introduction to Biotechnology, 1st Edition Academic press.
6. K. Pranav, V. Praveen, M. Usha (2017). Biotechnolgy A Problem Approach, Fifth edition Pathfinder Publications
7. Rup Lal (2020). An Introduction to Biotechnolgy- A Genetic Manipulation Perspective, First Edition Dreamtech Press

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– VI

Elective Course (EC-2)

Course Title: - Applications of Biotechnology in food, dairy and agriculture
Course Code: C6BIT5T1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
EC-2	**Theory**	**03**	**04**	**45hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcomes (COs): At the end of the course students will be able to:

CO1: Understanding the importance of food biotechnology
CO 2: Understanding the relevance of dairy biotechnology
CO 3: Understanding the role of biotechnology in agriculture

Unit	Title: Applications of Biotechnology in food, dairy and agriculture	45 hrs/ sem
Unit I	**Chapter No.1 Food Biotechnology** **A) Food as a substrate for microorganisms:** Intrinsic and extrinsic parameters affecting the growth of microbes. Microorganisms in food and their sources (molds, yeast and bacteria). **B) Spoilage of Food:** Principles of food spoilage, Sources of food contamination, Types of spoilage. Spoilage of meat and poultry, Fish and sea foods. Spoilage cereals, fruits and vegetables, Spoilage of canned food. **C) Food Preservation**: Principles of food Preservation. Methods of preservation Physical(temperature, drying, irradiation), chemical (Class I and Class II). Bio preservation. Canning, Food Packaging- Types of packaging materials, properties and benefits. **D) Quality control in Food**-Food Sampling, preparation and handling, Surface and environmental monitoring in food industry, basic physical and chemical analysis of food, Microbiological analysis of food and food products, Rapid microbiological and molecular methods to detect food pathogens	15 hrs
Unit II	**Chapter No.2 Milk and milk products:** A) Composition, properties, food and nutritional value B) Microbiology of milk, contamination, preservation, spoilage, testing of milk and milk products. C) Safety systems in dairy industries. D) Fermented milk products – cheese, yoghurt, shrikand, Kefir, Kumis and butter milk. **Chapter No.3 Food sanitation:** Sanitation in manufacture and retail trade; food control agencies and their regulations. Food safety laws and standards, Food packing International – HACCP, ISO 9000 series, GMP and GLP, FDA and EU India – PFAA, FPO, MPO, CSO, the AGMARK, standards, bureau of Indian Standards (BIS). Food testing laboratories in India - SRI, FRAC	15 hrs

UnitIII	**Microorganisms in Agriculture** **Microbiology of soil** **A) Introduction:** Type, soil profile, physical and chemical characters. Soil as habitat for microbes. Soil Microorganisms: Bacteria, fungi, actinomycetes. algae, protozoa and viruses. Role of Microbes in soil process. **B) Rhizosphere Microorganisms**: Rhizosphere and rhizoplane, Plant-microbe interaction: Mycorrhizae. **C) Bio-fertilizers:** Types (Bacterial, fungal, phosphate solubilizers. BGA. Plants-Azolla*)* Nitrogen fixation. Mass production, mode of applications, advantages and limitations of bacterial inoculants *(Rhizobium,Azotobacter)*	15 hrs

Books recommended:

Food Biotechnology

1. Adams, M. R. and Moss, M. O. (1995). Food Microbiology. Royal Society of Chemistry, Cambridge University Press.
2. Banwart, G. J. (1987). Basic Food Microbiology. CBS Publishers and distributors, New Delhi.
3. Betty C. Hobbs "Food Microbiology" Arnold-Heinamann Publishing Private Ltd. New Delhi.
4. Frazier & Westhoff, D. C. (1995). Food Microbiology Tata McGraw Hill Pub. Company Ltd., New Delhi.
5. Hammer B.W. and Babal "Dairy Microbiology" Prentice Hall Incorporated London.
6. Jay, J. M. (1985). Modern Food Microbiology.CBS Publishers and distributors, New Delhi.
7. Ribonson R.tC. 1990 "Dairy microbiology" Elsevier Application Dieness London.
8. Stanier, R.Y. Ingraham J.L (2001)"General Microbiology" Prentice Hall of India Pvt Ltd. New Delhi.
9. Varnam A.H. and Evans M.G. (1998) "Food borne Pathogens" Wolfe Publishing House. London.

Dairy Biotechnology

1. Dayte M.P., Lorry R.B. and Thomas J.M., Food Microbiology, ASM, Washington D.C.
2. Adams M.R. and Moss M.O. (2000) Food Microbiology. Royal Publishing Corporation.
3. Bibek Ray (2001). Fundamentals of Food Microbiology. Bibek Ray. 2nd Edition.CRC Press.
4. Bieleckis, Tramper J, Polak J. (2000), Food Biotechnology. Elsevier.
5. James. M. Jay (1996) Modern food Microbiology CBS Publishers and Distributors. Delhi.
6. John S. Norak, Gerald M. Sapers, Vijay Kumar Juneja, Daniel K Gay (2002), Microbial Safety of minimally processed foods 1st Edition CRC Press.
7. Ananthkrishnan C.P. et.al. (1994), dairy Microbiology, Sreelakshmi Publication., Chennai.
8. Robinson R.K. (1990), dairy microbiology, Elsevier Applied Science, London.
9. Mary. E. Torrence, Richard E. Isaacson (2003), Microbial Food Safety in Animal Agriculture: Current Topics Low State University Press.
10. Diam Robert. (2002), Food Microbiology: An Introduction. Black Well Publishers.

Agriculture Biotechnology

1. Alexander, A.M. (1987). Introduction to soil Microbiology, 5th ed., John Wiley and sons.
2. Atlas, R. M. and Bartha, R. (1993). Microbial Ecology: Fundamentals and applications, 3rd ed., Benjamin and Cummings Pub. Co., New York.
3. Brock, T.D "Principles and Microbial Ecology" Prentice Flail Publishing Co Philadelphia.
4. Clowod, D 1999 "Microbial Diversity" Academic Press. Co. New Delhi.
5. Mehrotra, R.S., Plant Pathalogy, Tata Mc Graw Hill Publications Limited, New Delhi.
6. Michael, J. Pelczar, Jr.E.C.S. Chan, Moel: Microbiology, Mc Graw Hill Book Company, New York).
7. Powar and Daginwala (1996). General Microbiology, Vol 1. Himalaya Publishing House, Bombay.
8. Powar and Daginwala (1996). General Microbiology, Vol 2. Himalaya Publishing House, Bombay.
9. Prescott. Lansing, M., Harley John P and KJein Donald. A "Microbiology" WCB. McGraw Hill New York

10. Rangaswamy, G. 1996 Diseases of crop in India. 3rd edn. prentice Hall of India Pvt. Ltd. New Delhi.
11. Rangaswamy, G. and Bagyaraj, D.J. (2001), Agricultural Microbiology, 2nd ed., Prentice Hall of India Pvt. Ltd., New Delhi.
12. Salle, A.J. "Fundamental Principles of Bacteriology" Tata McGraw Mill Publishing Company Ltd., New Delhi.
13. Stanier. R.Y. Ingraham J.L 'General Microbiology" Prentice Hail of India Pvt **Ltd.,** New Delhi.
14. Steward W.D.P. Nitrogen fixation in plants, The Alhione Press, London.
15. Subba Rao, N.S. (2002). Soil Microorganisms and Plant Growth 4th ed., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
16. Subbarao, MS. 1986 "Soil Microorganisms and Plant Growth'" 3Kl edn. Oxford and IBM publication Co. New Delhi.
17. Subba Rao, N.S. (1988). Biofertilizers in Agriculture, 2nd ed.Oxford and IBH Pub. Co., New Delhi.

Formative Assessment for Theory	
Assessment Occasion/type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV/ V/VI

Skill Enhancement Course (SEC)

Student shall study SEC in any one of the Semesters either in IV or V or VI semester

College shall decide to allot the students

Course Title: Immuno techniques
Course Code:C0BIT6P1

Type of Course	Theory /Practical	Credits	Instruction hour / week	Total No. of Lectures/ Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
SEC	**Practical**	**02**	**04**	**56hrs.**	**3hrs.**	**10**	**40**	**50**

Course Outcomes (COs): At the end of the course, students will be able to:

CO1: Understanding the relevance of immune reactions in diagnostics
CO2: Understanding the principles of immunology and their applications
CO3: Understanding of Immune interactions in diagnostic kits
CO4: Understanding the usage of immunology based kits

List of the Experiments, each will have 4Hrs/Week

1. Blood film preparation and identification of cells (WBC and RBC cells count)
2. Estimation of Hemoglobin.
3. Demonstration of antigen administration to animals Mice /Rat. (Intra-muscular, Intra- veinal, Intra-peritoneal)
4. Determination of Bleeding Time (BT) and Clotting Time (CT).
5. Separation of Serum / Plasma from whole blood,
6. Precipitation of Immunoglobulins from serum by Ammonium sulphate precipitation
7. Electrophoretic separation of serum proteins/plasma
8. Study of Agglutination tests (Haemagglutination, Latex agglutination, Bacterial agglutination).
9. Immunoprecipitation tests – Radial Immunodiffusion test / Ouchterlony double diffusion test.
10. Demonstration of ELISA
11. Demonstration of Western blot.
12. Widal test (Determination of antibody titre).
13. Immunoelectrophoresis – Rocket Immunoelectrophoresis.

Books recommended:

1. Abbas AK, Lichtman AHH, Shiv Pillai. (2017). Cellular and Molecular Immunology, 9th Edition, Elseiver Saunders Publishers.
2. Ananthanarayan, R and Paniker. (2017). Text book of Microbiology, 10th Edition, Universities press Private Limited, Hyderabad, India.
3. Bisen, S.P. (2014). Laboratory Protocols in Applied Life Sciences, CRC Press Taylor and Francis Group
4. CV Rao (2006) An Introduction to Immunology 2nd Edition, Alpha Science Intl Ltd.
5. Christopher, J., Burrell, Colin. R., Howard, Frederick. A. Murphy. (2016). Fenner and White's Medical Virology, 5th Edition, Academic Press.
6. Coleman RM, Lombard MF and Sicard RE. (2012). Fundamental Immunology, 7th Edition, LWW publication.
7. Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M. (2017). Roitt's Essential Immunology,13th Edition, Wiley-Blackwell Publishers

8. Frank Hay. (2002). Practical immunology, 4th Edition, Blackwell Science
9. IR Tizard, (1995), Immunology: An Introduction, 4thEdition, Saunders College Publishers, New York.
10. Plummer, D.T. (1971). Introduction to Practical Biochemistry, Tata MacGraw Hill.
11. Pavri, KM (1996), Challenge of AIDS, National Book Trust, India.
12. Owen, J., Punt, J., Stranford, S., Jones, P. (2018) Kuby Immunology, 8thEdition, W.H. Freeman & Company, New York.
13. Pommerville, J. (2014). Alcamo's Fundamentals of Microbiology. 10thEdition. Viva books Pvt ltd. New Delhi.
14. Tortora, G. J., Funke, R.B., Case, L.C. (2016). Microbiology: An Introduction 12thEditionPearson Publication.
15. William E., Md. Paul (Editor). (2012). Fundamental Immunology, 7th Edition, Lippincott Williams & Wilkins Publishers.

B.Sc. programme: 2024-25

GENERAL PATTERN OF **THEORY** QUESTION COURSE FOR DSC/ EC

(80 marks for semester end Examination with 3 hrs duration)

Part-A

1. Question number 1-10 carries 2 marks each. : 20 marks

Part-B

2. Question number 11- 18 carries 05Marks each. Answer any 06 questions : 30 marks

Part-C

3. Question number 19-22 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 80 Marks

Note: Proportionate weight age shall be given to each unit based on number of hours Prescribed