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)/2024-25/436 Date: 11 NOV 2024

ಅಧಿಸೂಚನೆ

ವಿಷಯ: ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ಪದವಿಗಳಿಗೆ / ಸ್ನಾತಕೋತ್ತರ ಡಿಪ್ಲೋಮಾಗಳಿಗೆ ಪಠ್ಯಕ್ರಮವನ್ನು ಪ್ರಕಟಣೆ ಕುರಿತು.

ಉಲ್ಲೇಖ: 1. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ: 2 ರಿಂದ 9, ದಿ: 08.11.2024.

2. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಅನುಮೋದನೆ ದಿನಾಂಕ: 11.11.2024.

ರಾಷ್ಟ್ರೀಯ ಶಿಕ್ಷಣ ನೀತಿಯನುಸಾರ 2024–25ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ಪದವಿಗಳಾದ M.A./ M.Sc / M.Com / MBA / M.Ed 1 ರಿಂದ 4ನೇ ಸೆಮೆಸ್ಟರ್‌ಗಳಿಗೆ ಮತ್ತು 1 & 2ನೇ ಸೆಮೆಸ್ಟರ್‌ಗಳ ಸ್ನಾತಕೋತ್ತರ ಡಿಪ್ಲೋಮಾಗಳಿಗೆ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದನೆಯೊಂದಿಗೆ ಈ ಕೆಳಗಿನಂತೆ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಅಳವಡಿಸಿಕೊಳ್ಳಲಾಗಿದೆ. ಕಾರಣ, ಸಂಬಂಧಪಟ್ಟ ಎಲ್ಲ ಸ್ನಾತಕೋತ್ತರ ವಿಭಾಗಗಳ ಅಧ್ಯಕ್ಷರು / ಸಂಯೋಜಕರು / ಆಡಳಿತಾಧಿಕಾರಿಗಳು / ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳು / ಶಿಕ್ಷಕರು ಸದರಿ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಅನುಸರಿಸುವುದು ಮತ್ತು ಸದರಿ ಪಠ್ಯಕ್ರಮವನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭತ್ತರಿಸಲಾಗಿದನ್ನು ಸಂಬಂಧಪಟ್ಟ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಸೂಚಿಸುವುದು.

Arts Faculty

Sl.No	Programmes	Sl.No	Programmes
1	Kannada	8	MVA in Applied Art
2	English	9	French
3	Folklore	10	Urdu
4	Linguistics	11	Persian
5	Hindi	12	Sanskrit
6	Marathi	13	MPA Music
7	MVA in Painting		

Faculty of Science & Technology

Sl.No	Programmes	Sl.No	Programmes
1	Geography	10	M.Sc (CS)
2	Chemistry	11	MCA
3	Statistics	12	Marine Biology
4	Applied Geology	13	Criminology & Forensic Science
5	Biochemistry	14	Mathematics
6	Biotechnology	15	Psychology
7	Microbiology	16	Applied Genetics
8	Zoology	17	Physics
9	Botany	18	Anthropology

Faculty of Social Science

Sl.No	Programmes	Sl.No	Programmes
1	Political Science	8	Journalism m & Mass Commn.
2	Public Administration	9	M.Lib. Information Science
3	History & Archaeology	10	Philosophy
4	A.I.History & Epigraphy	11	Yoga Studies
5	Economics	12	MTTM
6	Sociology	13	Women's Studies
7	MSW		

Management Faculty

Sl.No	Programmes	Sl.No	Programmes
1	MBA	2	MBA (Evening)

Faculty of Commerce

Sl.No	Programmes	Sl.No	Programmes
1	M.Com	2	M.Com (CS)

Faculty of Education

Sl.No	Programmes	Sl.No	Programmes
1	M.Ed	2	M.P.Ed

OEC subject for PG

Sl.No	Programmes	Sl.No	Programmes
1	Russian	5	Veman Peetha
2	Kanaka Studies	6	Ambedkar Studies
3	Jainology	7	Chatrapati Shahu Maharaj Studies
4	Babu Jagajivan Ram	8	Vivekanand Studies

PG Diploma

Sl.No	Programmes	Sl.No	Programmes
1	PG Diploma in Chatrapati Shahu Maharaj Studies	2	P.G. Diploma in Women's Studies
3	P.G. Diploma in Entrepreneurial Finance		

ಕುಲಸಚಿವರು.

ಅಡಕ: ಮೇಲಿನಂತೆ

ಗೆ,

1. ಕ.ವಿ.ವಿ. ಸ್ನಾತಕೋತ್ತರ ಅಧ್ಯಕ್ಷರುಗಳಿಗೆ / ಸಂಯೋಜಕರುಗಳಿಗೆ / ಆಡಳಿತಾಧಿಕಾರಿಗಳಿಗೆ / ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ
2. ಎಲ್ಲ ನಿಖಾಯದ ಡೀನರು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿಎಚ್.ಡಿ) ವಿಭಾಗ/ ಸಿಸ್ಟಮ್ ಅನಾಲೆಸಿಸ್ಟ್ / ಸಂಬಂಧಿಸಿದ ಪದವಿಗಳ ವಿಭಾಗಗಳು, ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
6. ನಿರ್ದೇಶಕರು, ಐ.ಟಿ. ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ ಇವರಿಗೆ ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಲ್ಲಿ ಪ್ರಕಟಿಸುವುದು.

KARNATAK UNIVERSITY, DHARWAD

PG Programme

M.Sc. Applied Genetics

Curriculum Structure

With Effect from 2024-25

As Per NEP - 2020

Karnatak University, Dharwad

M.Sc..in **APPLIED GENETICS**
Effective from**2024-25**

Sem.	Type ofCourse	Theory/ Practical	Course Code	CourseTitle	Instructionhour/ week	Total hours / sem	Duration ofExam	Marks			Credits
								Formative	Summative	Total	
I	DSC-1	Theory	A1GEN001T	BIOLOGICAL CHEMISTRY (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-2	Practical	A1GEN001P	BIOLOGICAL CHEMISTRY (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-3	Theory	A1GEN002T	GENETICS AND CYTOGENETICS (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-4	Practical	A1GEN0012P	GENETICS AND CYTOGENETICS (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-5	Theory	A1GEN003T	GENERAL MICROBIOLOGY (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-6	Practical	A1GEN003P	GENERAL MICROBIOLOGY (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-7	Theory	A1GEN004T	BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES (Theory)	04	60hrs	02hrs	20	80	100	04
	DSC-8	Practical	A1GEN004T	BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
								120	**480**	**600**	**24**
II	DSC-9	Theory	A2GEN001T	DEVELOPMENTAL AND EVOLUTIONARY GENETICS (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-10	Practical	A2GEN001P	DEVELOPMENTAL AND EVOLUTIONARY GENETICS (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-11	Theory	A2GEN002T	MOLECULAR BIOLOGY (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-12	Practical	A2GEN002P	MOLECULAR BIOLOGY (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-13	Theory	A2GEN003T	INTERMEDIARY METABOLISM (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-14	Practical	A2GEN003P	INTERMEDIARY METABOLISM (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	OEC - 1	Theory	A2GEN201T	RECOMBINANT DNA TECHNOLOGY AND MOLECULAR CLONING (Theory)	04	60hrs	02hrs	20	80	100	04

								110	**440**	**550**	**22**
Sem.	**Type ofCourse**	**Theory/Practical**	Course Code	CourseTitle	**Instruction hour/week**	**Total hours / sem**	**Duration ofExam**	**Marks**			**Credits**
								Formative	**Summative**	**Total**	
III	DSC-9	Theory	A3GEN001T	GENETIC ENGINEERING (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-10	Practical	A3GEN001P	GENETIC ENGINEERING (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-11	Theory	A3GEN002T	MICROBIAL GENETICS AND TECHNOLOGY (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-12	Practical	A3GEN002P	MICROBIAL GENETICS AND TECHNOLOGY (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-13	Theory	A3GEN003T	HUMAN GENETICS AND GENETIC COUNSELLING (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-14	Practical	A3GEN003P	HUMAN GENETICS AND GENETIC COUNSELLING (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	OEC - 1	Theory	A3GEN202T	MOLECULAR DIAGNOSIS AND MOLECULAR MEDICINE (THEORY)	04	60hrs	02hrs	20	80	100	04
								110	**440**	**550**	**22**
IV	DSC-9	Theory	A4GEN001T	FOURTH SEMESTER BIOINFORMATICS (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-10	Practical	A4GEN001P	BIOINFORMATICS (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-11	Theory	A4GEN002T	IMMUNOGENETICS AND IMMUNOTECHNOLOGY (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-12	Practical	A4GEN002P	IMMUNOGENETICS AND IMMUNOTECHNOLOGY (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	DSC-13	Theory	A4GEN003T	GENETICS OF CROP IMPROVEMENT (THEORY)	04	60hrs	02hrs	20	80	100	04
	DSC-14	Practical	A4GEN003P	GENETICS OF CROP IMPROVEMENT (PRACTICAL)	04	56 hrs	03hrs	10	40	50	02
	Project - 1	Practical	A4GEN004P	PROJECT WORK				25	125	150	06
								115	**485**	**600**	**24**

GENERAL INSTRUCTIONS

1. One credit is equal to 1 hour theory teaching per week.
2. One credit is equal to 2 hour practical teaching per week.
3. One credit is equal to 15 hours theory syllabus per semester (1 Unit is equal to 15 Hours)
4. One credit is equal to 30 hours practical syllabus per semester (1 credit practical is equal to 2 hours per week)

A. Workload for theory subjects

1. There shall be 16 hrs/week workload for Assistant Professor
2. There shall be 14 hrs/week workload for Associate Professor/ Professor/Senior Professor.
3. There shall be 2hrs/week workload relaxation for Guiding Ph.D. students

B. Workload for practical subjects

1. There shall be 20 hrs/week workload for Assistant Professor
2. There shall be 18 hrs/week workload for Associate Professor/ Professor/Senior Professor.
3. There shall be 2hrs/week workload relaxation for Guiding Ph.D. students

C. Workload for practical batches

1. A batch of 10-12 students shall have 1 teacher

D. Workload for Project

1. Students for projects shall be preferably guided by permanent faculty for atleast10 students by sharing equally among the permanent faculty. If remained excess shall be allotted to other teacher's onroll on temporary basis.
2. If there are no permanent faculty, the students shall be distributed among the temporary teachers onroll.
3. There shall be maximum of 4 hrs/week workload for guiding the students for project work irrespective of number of students.

E. Allotment of Specialization

While allotting specialization in 3rd and 4th semester, minimum of 10 students shall have to select the specialization.

F. Marks and Conduct of Examination

1. Generally, 20% weightage for Formative assessment and 80% weightage for Summative assessment
2. Upto 2 credits equal to 50 marks (10 marks Formative assessment and 40 marks summative assessment)
3. 3-4 credits equal to 100 marks(20 marks Formative assessment and 80 marks summative assessment)
4. 5-6 credits equal to 150 marks(30 marks Formative assessment and 120 marks summative assessment)

5. Example for 100 marks out of which 20 marks for Formative assessment i.e.,Formative Assessment shall be in two stages:10 marks for 8th week and 10 marks for 14thweek of every semester.

6. 75% attendance is mandatory for every course(paper). No marks are reserved for attendance. If the candidate fails to fulfils 75% attendance in any one of the course (paper) in the given semester, such candidate is not eligible to appear for examination in all the papers and candidate has to get the readmission for such semester.

7. Passing criteria: Candidate has to score minimum 40% in summative examination and fulfill 40% of the maximum marks including Formative assessment marks. For example: for 80 marks summative examination, candidate has to score minimum of 32 marks (40%) and should score cumulatively 40 marks including formative assessment.
8. Candidate has to score 40% as above in all the courses to pass the semester end examination.
9. Marks obtained from the OEC shall not be considered for award of CASH PRIZE/RANK/GOLD MEDAL.

G. Project/Internship assessment

1. Formative Assessment : Project/Internship assessment carrying 20 marks out of 100 marks
   Interaction with the project supervisor and submission of progress reports = 10 + 10 marks
2. Summative Assessment : Project/Internship assessment carrying 80 marks out of 100 marks
   a. Project Report : 35
   b. Presentation : 20
   c. Viva-voce : 25

FIRST SEMESTER
A1GEN001T: BIOLOGICAL CHEMISTRY (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 1	DSC 1	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to

CO1: To offer detailed knowledge of biomolecules for living systems

CO2: To provide basic concepts of structural organization of biomolecules

CO3: To learn about biomolecular interactions in biochemical processes

CO4: To acquire knowledge on physicochemical properties of biomolecules

CO5: To understand the structure of DNA and RNA and their types

Syllabus Course 01(Theory): BIOLOGICAL CHEMISTRY	**Total Hrs: 60**
Unit-I	**15 Hours**
Chemical Bonds: Covalent, coordinate, electrostatic, hydrogen, ionic bonds, Van der Waals forces, hydrophilic and hydrophobic interactions, functional groups. **Properties of Water**: Structure and properties of water, water as a solvent, its importance in biological systems, importance of pH, pK, and buffer, Henderson-Hasselbalch equation and its application.	
Unit-II	**15 Hours**
Carbohydrates: Classification, methods of structure elucidation. Structure and stereochemistry of carbohydrates. Derivatives of monosaccharides: amino sugars, deoxy sugars, glycosides. Structure of disaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen, dextrin, hemicellulose, pectins, lignins, agar-agar, chitin, hyaluronic acid, heparin, chondroitin sulphate, peptidoglycan).	

Proteins: Amino acids—structure, reactions, and physiological properties. Peptides: peptide bond, structure determination, isolation, and synthesis. Protein structure (primary, secondary, tertiary), denaturation, isolation, purification, and chemical reactions.	
Unit-III	**15 Hours**
Lipids: Classification, fatty acid chemistry, triacylglycerides, drying of oils, saponification and iodine values of oils and fats. Structure of phospholipids (lecithin, cephalin) and sphingolipids. **Terpenes**: Structure of cholesterol, classification of terpenes, chemistry of farnesol, phytol, squalene, and carotenes	
Unit-IV	**15 Hours**
Nucleotides: Chemistry of nucleic acids, purines, pyrimidines, nucleosides, nucleotides, and DNA/RNA structures. **Vitamins**: Chemistry, classification (fat and water-soluble), biological functions. **Antibiotics**: Structure and chemistry of penicillin, streptomycin, chloramphenicol, tetracyclines. **Alkaloids**: General introduction, medicinally important alkaloids. **Pigments**: Chlorophylls, heme, phenolics, and tannins. **Metal Ions in Biomolecules**: Examples and their roles.	

A1GEN001P: BIOLOGICAL CHEMISTRY (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 2	DSC 2	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to

CO1: Acquire hands on experience to perform general and confirmatory qualitative tests For identification of Carbohydrates, Proteins and amino acids, Lipids etc.

CO2: Get hands on experience on various biochemical techniques such as Paper chromatography, Thin layer chromatography, and handling Colorimeter and Spectrophotometer

CO3: Estimate the quantity of various biomolecules from living system

1. Preparation of buffers: citrate, Tris-HCl, and phosphate buffers.
2. Determination of pK of proteins and amino acids.
3. Estimation of inorganic phosphorus using the Fiske-Subbarow method.
4. Sorenson-Formol titration for estimation of % purity of glycine.
5. Isolation and estimation of proteins by Biuret method
6. Isolation and estimation of proteins by FCR method
7. Determination of molecular weight of a protein by gel filtration or SDS-PAGE.
8. Estimation of total sugars/reducing sugars.
9. Estimation of DNA by DNS method
10. Estimation of DNA/RNA.
11. Extraction and estimation of plant pigments.
12. Extraction of lipids and fatty acid composition (TLC or GLC).
13. Determination of saponification value of oils
14. Determination of iodine number of fats.

(New experiments may be introduced each year)

References:

1. Nelson, D.I., & Cox, M.M., Lchninger, A.L. (2000). *Principles of Biochemistry*, 3rd Ed., McMillan Press.
2. Mathews, C.K., Van Holde, K., & Ather, K. (2000). *Biochemistry*, 5th Ed., Benjamin/Cummings Publishing.
3. Voet, D., & Voet, J. (2000). *Biochemistry*, John Wiley & Sons.
4. Stryer, L. (2000). *Biochemistry*, 5th Ed., W.H. Freeman.
5. Roberts, J.D., & Caserio, M.C. (1974). *Basic Principles of Organic Chemistry*, 1st Ed., W.A. Benjamin, Inc.
6. BloomField, V.A., & Harrington, I.L.E. (1995). *Biophysical Chemistry*, W.H. Freeman.
7. Sadasivam, S., &Manikam, A. (1992). *Biochemical Methods for Agricultural Sciences*, Wiley Eastern Ltd.
8. Jayaraman, J. (1968). *Laboratory Manual for Biochemistry*, Wiley Eastern Ltd.
9. Plummer, D.T. (1977). *Introduction to Practical Biochemistry*, Tata McGraw Hill.
10. Palanivelu, D. (2001). *Analytical Biochemistry and Separation Techniques*, A Laboratory Manual for B.Sc. and M.Sc. Students.

A1GEN002T: GENETICS AND CYTOGENETICS (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 3	DSC 3	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Define and identify Mendel's laws, gene interactions, linkage, cell cycle and chromosome morphology and structure

CO2: Identify violation in mendelism and explain the principles

CO3: have an deep insight in principles of linkage and recombination and its application

CO4: learn the application of cytogenetic principles in plant and animal improvement

Syllabus Course 03(Theory): GENETICS AND CYTOGENETICS	**Total Hours: 60**
Unit- I	**15 Hours**
History of Genetics:Genetics in biology. Role of genetics in agriculture, industry, and medicine, impact on society. Overview of Mendelian genetics. Application of laws of probability (product rule, sum rule, binomial property). Chi-square test and its application in analysis of genetic data. **Extension of Mendelism**: Basis of dominant and recessive mutation. Visible, sterile, and lethal mutations. Genotype to phenotype, effect of environment on phenotype development—penetrance and expressivity, phenocopies. Overview of gene interaction and modifying genes. Pleiotropy. Multiple alleles—Eye color in fruit fly, coat color in locus in maize. Testing gene mutation for allelism complementation.	
Unit-II	**15 Hours**
Linkage, Recombination, and Gene Mapping in Eukaryotes: Recombination frequency and map function. Linkage studies in fruit fly and maize. Detection of linkage by test cross. Two-point cross, three-point cross, and four-point cross and gene mapping. Coincidence and interference. Recombination frequency and genetic map distance, chiasma frequency, and genetic map distance, genetic distance and physical distance. Evolutionary	

significance of recombination. Genetic control of recombination. Cytogenetic and physical maps using molecular markers. **Sex Determination**: Autosomes and sex chromosomes—fruit fly, birds, *Melandrium*, and humans. Sex-linked, sex-limited, and sex-influenced characters. Environmental determination of sex. Dosage compensation of X-linked genes. Molecular mechanism of sex determination. **Inheritance of Quantitative Traits**:Continuous and discontinuous variations. Polygenic inheritance, genetic variance, heritability—narrow sense and broad sense, genetic advance under selection.	
Unit-III	**15 Hours**
Extrachromosomal Inheritance: Non-Mendelian inheritance, variegation in leaves of higher plants, Correns' studies in *Mirabilis jalapa*. Extra-nuclear genes in *Chlamydomonas* mutants showing uniparental inheritance, chloroplast, and mitochondrial genome. **Eukaryotic Chromosome**: Chromatin, its chemical nature, macromolecular organization. Nucleosome structure, chromosome model, centromeric DNA, telomere organization. Law of DNA constancy and C-value paradox. **Mechanism of Cell Division**: Mitotic apparatus, cytokinesis, chromosome movement. Overview of cell cycle, molecular mechanism of regulating mitotic events, cell cycle control in mammalian cells. Mutation causing loss of cell cycle control. **Meiotic Process**: Stages, chromosome pairing, and chiasma formation. Molecular mechanism of recombination, synaptonemal complex, and recombination nodule. Spermatogenesis and oogenesis. Biochemical studies with oocytes, eggs, and early embryos.	
Unit-IV	**15 Hours**
Haploidy: Occurrence, production, detection, meiosis, breeding behavior, use in genetic analysis and plant breeding. **Polyploidy**: Autopolyploidy—origin, induction, cytological, genetic, and breeding behavior. Allopolyploidy—cytogenetics, genome analysis, synthesis of new genera. Polyploidy in the animal kingdom. **Aneuploidy**: Hyperploids—trisomics and tetrasomics—origin, meiotic behavior, and uses. Hyperploidy in animals and humans. Hypoploidy—monosomies and nullisomies—source, cytological behavior, genetics, and their uses in gene mapping.	

Chromosome Engineering: Transfer of whole genome, genome reconstruction, chromosome sorting, transfer of individual chromosomes, substitution of alien chromosome arm. **Cytogenetic Basis of Apomixis**: Classification, detection, embryological, cytological, and genetic basis. Apomixis in plant breeding.	

A1GEN0012P: GENETICS AND CYTOGENETICS (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 4	**DSC4**	**Practical**	**2**	**4**	**56**	**3**	**10**	**40**	**50**

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Able to collect, handle and culture *Drosophila*

CO2: learn the application of fruitfly in understanding Mendelian principles

CO3: able to prepare slides to study karyological events

1. Preparation of fruit fly media and handling of fruit flies.
2. Identification of adult fruit fly morphology and life cycle study.
3. Examination of mutant flies and gene interactions.
4. Analysis of segregation and independent assortment in fruit flies.
5. Linkage studies in fruit flies.
6. Preparation of media and culture methods for *Neurospora* and *Sordaria*.
7. Tetrad analysis in *Neurospora* and *Sordaria*.
8. Cytological methods: Chromosome counting and banding techniques.
9. Analysis of polytene chromosomes, sex chromosomes.
10. Structural and numerical changes in chromosomes.
11. Induction of polyploidy and characterization of autoploids.

(New experiments may be introduced each year)

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A1GEN003T: GENERAL MICROBIOLOGY (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 5	DSC5	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: learn basic principles of microbiology

CO2: understand the techniques of sterilization, media composition and cultivation of microbes

CO3: understand the role of microbes in health, agriculture, environment and industry

Syllabus Course 05(Theory): GENERAL MICROBIOLOGY	**Total Hours: 60**
Unit-I	**15 Hours**
Introduction: Scope and development of microbiology, comparative study of prokaryotic and eukaryotic microorganisms. Study of structure of bacteria, genetic elements, ribosomes, membranes, cell envelope, capsule, flagella, pili, and endospores. **Classification of Microorganisms**: Nomenclature and study of different types of microorganisms. Characterization of microorganisms: bacteria, fungi, actinomycetes, algae, protozoa, mycoplasmas, chlamydiae, rickettsiae. **Methods of Sterilization**: Principles, physical and chemical sterilizing agents, pasteurization, and disinfection; batch and continuous sterilization of media and air. **Nutrition and Culture Media**: Nutritional requirements and classes of microorganisms. Types of culture media: selective, differential, indicator, and transport media.	
Unit-II	**15 Hours**
Isolation of Pure Cultures: Different methods of isolation and pure cultures—spread plate, pour plate, and streak plate methods. Enumeration of cell numbers, enrichment culture techniques. **Cultivation of Bacteria**: Methods of inoculation and culturing—streak, stab,	

lawn or carpet culture, liquid culture. Growth and reproduction in microorganisms, growth curve of bacteria, factors affecting the growth curve, synchronous and diauxic growth. Methods of growth measurement: plating, turbidometry, metabolic products, nitrogen content. Preservation of microbial cultures—stabbing glycerol. **Identification of Bacteria**: Morphological identification, staining methods: simple staining, capsule, cell wall, flagella, and endospore staining. Biochemical identification: IMViC test, oxidase, catalase, urease, sugar fermentation, and H_2S production.	
Unit-III	**15 Hours**
Habitats of Microorganisms: Microbes of air, water, soil, food, and normal human body flora. **Viruses**: Physiochemical properties and classification of viruses. Isolation, cultivation, and assay of viruses. Bacteriophages: odd and even T phages, ΦX174. Structure, mode of infection, replication, and assembly of T even phage. Lytic and lysogenic cycles. Viroids and prions. **Clinical Microbiology**: Infection and intoxication, endotoxins and exotoxins, air, water, and foodborne diseases in humans and domestic animals—causative agents, epidemiology, and diagnosis. A. Microbial antibiotics: curative and prophylactic measures. B. Monoclonal antibodies: production and application. C. Insulin production by genetically engineered microbes (GEM). D. Vaccines: killed, attenuated, and recombinant vaccines. E. Integrated pest control management.	
Unit-IV	**15 Hours**
Food Microbiology : A . Microbes in the spoilage of food and milk and their prevention. B. Microbes in the production of food-cheese, vitamins, amino acids, organic acids and in alcoholic beverages. C. Microbes as food: Single Cell protein from algae, bacteria, yeast and fungi as mushroom. **Environmental and Fuel Microbiology:** Environmental pollution: Agricultural domestic and industrial wastes A. Microbes in liquid and solid waste management B. Sacchrirification, Silage production and composting microbes in degradation of pesticides and Xenobiotics ; Microbial fertilizers; biological control of pest by B.thurengiensis. C. Metal leaching and extraction, microbes as non conventional energy source, Biogas production, Methane and butanol and hydrogen gases; Alcohol production	

A1GEN003P: GENERAL MICROBIOLOGY (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 6	DSC6	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: able to prepare culture media, isolate microbes and prepare pure cultures

CO2: perform various staining and biochemical procedures to identify bacteria

CO3: carryout growth curve analysis of bacteria

1. Preparation of nutrient broth and nutrient agar slants, and sterilization.
2. Culture of microorganisms using various methods.
3. Isolation of microorganisms from soil samples
4. determination of the number of colony-forming units and scoring colony morphology
5. Isolation of pure culture techniques.
6. Preparation of stains and mordants and destaining solutions
7. Simple staining using crystal violet, safranin, methylene blue and Negative staining
8. Differential staining procedures: endospore staining, flagellar staining, cell wall staining, capsular staining
9. Identification of bacteria by biochemical tests.
10. Life cycle of bacteria, fungi, actinomycetes, blue-green algae, and *Clostridium*.
11. Antibiotic sensitivity test, LD-50, potency of drug/antibiotic.
12. Study of the growth curve of *E. coli* cells—effect of pH, temperature, salt concentration, nutrient, and agitation on growth phases.
13. Clinical microbiology techniques: tests for infection and intoxication, toxin detection.
14. Isolation of Phages by chloroform precipitation

(New experiments may be introduced each year)

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A1GEN004T: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES (Theory)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 7	DSC7	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the characters of biomolecules

CO2: have an insight about the principles of techniques like microscopy and microtomy

CO3: Learn the principle of separation techniques and analytical techniques

Syllabus Course 07 (Theory):BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES	**Total Hours: 60**
Unit-I	**15 Hours**
Introduction: Scope of biophysics, physical laws, interaction of living and non-living matter, chemical foundations of biophysics. **Characterization of biological molecules:**Hydrodynamic properties of biomolecules-viscosity, diffusion, osmosis, partial specific volume, and Donnan effect. **Microscopy:** Principles of microscopy-light, phase contrast, fluorescence, X-ray, UV, transmission and scanning electron microscope, confocal microscope, and atomic force microscope. **Preparation of specimen for microscopy:**Microtome technique, fixation, embedding, sectioning, and staining for light and electron microscopy.	
Unit-II	**15 Hours**
Chromatography: Paper, thin-layer, gas-liquid, column, gel filtration, ion exchange, affinity, HPLC, RPLC. **Centrifugation:**Preparative and analytical centrifuges, rotors, sedimentation analysis, rate-zonal and equilibrium gradient centrifugation, ultracentrifugation, subcellular isolation. **Electrophoresis:**Types of electrophoresis—paper and gel (starch,	

acrylamide, and agarose) electrophoresis, capillary, disc, slab vertical gel electrophoresis, submarine horizontal agarose gel electrophoresis, gradient gel electrophoresis, isoelectric focusing, immune-electrophoresis, pulsed-field gel electrophoresis, blotting of nucleic acids and proteins from gel to solid supports.	
Unit-III	**15 Hours**
Concentration of macromolecules: Salting out with ammonium sulfate, flash evaporation, lyophilization, pressure dialysis, reverse dialysis, hollow fiber membrane, and reverse osmosis. **Analytical methods:**Spectroscopy, photobiophysics, electromagnetic spectrum of light, simple theory of absorption of light by molecules, Beer-Lambert's law, types of detectors. UV-Visible spectrophotometry, infrared spectroscopy, Raman spectroscopy, fluorescence spectroscopy, flame photometry, atomic absorption, plasma emission, mass spectrometry, ESR and NMR spectroscopy, MALDI-TOF MS, LC-MS, ORD and CD, X-ray diffraction, and X-ray crystallography.Biological importance of LASERS, microwaves, and radiations.	
Unit-IV	**15 Hours**
Radioisotope tracer techniques: Nature and types of radioactivity, decay units, preparation of labeled biological compounds, detection and measurement of radioactivity (GM counter, scintillation counter, Cerenkov radiation, autoradiography, photographic emulsion, gamma-ray counter), quench correction, safety measures in handling radioisotopes, biological uses of radioisotopes. **Automatic analyzers:**For amino acids, protein sequencers, nucleotide sequencing systems, peptide and polynucleotide synthesizers. **Methods of detection and quantization of macromolecules on gels:**Staining procedures for proteins, nucleic acids, carbohydrates, pigments. Zymograms, densitometric methods, and transilluminators.	

A1GEN004T: BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 8	**DSC8**	**Practical**	**2**	**4**	**56**	**3**	**10**	**40**	**50**

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: purify biomolecules from the natural sources

CO2: have an insight about the principles of techniques like microscopy and microtomy

CO3: Learn the principle of separation techniques and analytical techniques hands on

1. Purification of peptides/proteins: salt precipitation, dialysis, column purification.
2. Molecular weight determination of peptides/proteins by gel filtration chromatography/SDS-PAGE.
3. Blotting of nucleic acids/proteins.
4. Extraction of lipids and analysis of fatty acid composition.
5. Estimation of hormones by HPLC.
6. Analysis of elements using AAS/Flame photometer/Kjeldahl method.
7. Use of light, phase contrast, fluorescence, and electron microscopy for examining specimens.
8. Chromatography techniques: paper, thin-layer, and column chromatography.
9. Gel filtration chromatography for protein purification.
10. Spectrophotometric techniques for quantifying biomolecules.
11. Use of UV-Visible and fluorescence spectroscopy for analysis.
12. Use of GM counters and scintillation counters for measuring radioactivity.
13. Autoradiography techniques for detecting radioactive isotopes.
14. Quantitative analysis of macromolecules on gels using staining and densitometry.

(New experiments may be introduced each year)

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SECOND SEMESTER
A2GEN001T. DEVELOPMENTAL AND EVOLUTIONARY GENETICS

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 9	DSC9	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the principles of animal development

CO2: understand the principles of plant development

CO3: understand the principles of evolution and evolutionary processes

Syllabus Course 09(Theory): DEVELOPMENTAL AND EVOLUTIONARY GENETICS	**Total Hours: 60**
Unit-I	**15 Hours**
History and Basic Concepts: Model organisms for genetic analysis of development: Insect - *Drosophila*, amphibians - *Xenopus levis*, birds - chick, mammals - mouse, identifying developmental genes. **Patterning of the Vertebrate Body Plan**: Axes and germ layers - settling of the body axes, mesoderm and early nervous system - somite formation and patterning, neural induction and the role of the organizer. **Development of Fruit Fly Body Plan**: Maternal gene activity, polarization of body axes during oogenesis, zygotic gene activity in early embryo, segmentation - activation of pair rule genes, selector and homeotic genes, segment polarity genes and compartments.	
Unit-II	**15 Hours**
Genetics of Embryonic Development in Plant: Early events in embryogenesis, gene expression in embryo, genetics of embryogenesis - embryolethal mutants, apical-basal axis mutants, segment deletion mutant, radial axis mutants. Cell fate maps in embryo development. **Genetics of Seedling Development**: Photomorphogenesis, shoot development, leaf development, and root development.	

Genetics of Flowering, Seed and Fruit Development: Transition from vegetative to floral development, ABC model and homeotic genes, mad box genes. Genetics of anther development and pollen formation. Seed development - Endosperm, endosperm balance number, maturation stage, LEA protein and control of seed dormancy and germination. Fruit development and control of ripening. Genetics of aging and senescence in animals and plants.	
Unit-III	**15 Hours**
Theories of Organic Evolution: Lamarckism and neo-Lamarckism, Darwinism and neo-Darwinism. Gene frequencies and equilibrium. Gene pool and gene frequency. Hardy-Weinberg law, attainment of equilibrium at 2 or more loci and sex linkage. Estimation of equilibrium frequencies in natural population - Codominance and dominance in natural population, sex linkage in natural populations. **Changes in Gene Frequencies**: Mutation rate, selection, fitness, gametic and zygotic selection, heterozygous advantage. Unstable equilibrium, equilibrium between mutation and selection. Mutation rate and equilibrium frequencies estimation, migration, random genetic drift. **Inbreeding and Heterosis**: Inbreeding and assortative mating, inbreeding coefficient from genotypes and pedigrees. Effect of inbreeding on genotype frequencies, phenotypic mean and variance. Cross breeding and heterosis.	
Unit-IV	**15 Hours**
Genetic Structure of Population: Optimum phenotype and selection pressure, types of selection, Fischer's theorem on natural selection, genetic variability in natural populations, canalization, genetic homeostasis, genetic load and genetic drift. **Genetics of Evolutionary Process**: Race formation, isolating mechanisms, modes of speciation. **Genetic Polymorphism**: Types of polymorphism, maintaining polymorphisms, sampling the genome, multilocus selection models, neutral alleles, molecular evolutionary clock. **Molecular Phylogenies and Evolution**: Amino acid sequences, DNA and repetitive DNA sequences, DNA-DNA hybridization, restriction enzyme sites. Molecular polymorphism and its evolutionary implications. Nucleotide sequence homologies, rate of molecular	

changes, regulating genes, and evolutionary consequences.	

A2GEN001P: DEVELOPMENTAL AND EVOLUTIONARY GENETICS (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 10	**DSC10**	**Practical**	**2**	**4**	**56**	**3**	**10**	**40**	**50**

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Learrn the techniques

CO2: understand the principles of plant development

CO3: understand the principles evolution and evolutionary processes

1. Fixation of plant and animal tissues, preparation of paraffin blocks and microtomy. Staining and microscopic observations.
2. Types of eggs and cleavage.
3. Development of *Arabidopsis*, fruit fly, fish, frog, and mammals.
4. Mounting of imaginal discs in fruit fly.
5. Demonstration of cell death.
6. Gametogenesis, embryogenesis, and seed development.
7. Root and shoot differentiation.
8. Estimation of allelic frequency in natural population - PTC loci.
9. Genetic variation in natural population - beak shape, color pattern in lady beetle, flower color variation, mimicry - butterfly and orchid flowers, Metroglyph analysis.
10. Estimation of genetic diversity in natural population.
11. Mechanism of speciation - Polyploidy.
12. Genetic analysis of inbreeding.

(New experiments may be introduced each year)

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A2GEN002T: MOLECULAR BIOLOGY

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 11	DSC11	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand structure of the genetic material

CO2: understand the principles replication, transcription and translation of genetic material

CO3: understand the principles gene expression regulation and its application

Syllabus Course 09(Theory): MOLECULAR BIOLOGY	**Total Hours:60**
Unit-I	**15 Hours**
Genetic Material: Discovery, Overview - DNA - Chemical composition and molecular structure, polymorphism in DNA structure. RNA - Chemical composition and macromolecular structure and types of RNA. **DNA Replication**: Overview, enzymes of replication. Replication apparatus - Primosomes and Replisomes. Mechanism of Replication. Continuous and discontinuous DNA synthesis, supercoiling and termination of replication. Eukaryotic DNA Replication, telomere length and aging.	
Unit-II	**15 Hours**
Transcription: Central dogma, role of DNA in protein synthesis, general features of RNA synthesis. Prokaryotic transcription RNA polymerase, mechanism of transcription. Eukaryotic transcription - RNA polymerases, transcription factor. **Post-transcription Modification of mRNA**: Capping and Polyadenylation. Split genes- intron, exons, and gene splicing. Reverse transcription. **Translation**: Genetic code - Properties of genetic code, deciphering of genetic code, initiation and termination codons, degeneracy of genetic code, quasi-universal nature of genetic code, wobble hypothesis and evolution of genetic code. Protein synthesis - ribosomes, amino acid activation, initiation, elongation, and termination in prokaryotes and	

eukaryotes, post-translational modification of proteins. Inhibitors of translation.	
Unit-III	**15 Hours**
Mutagenesis: Spontaneous mutations. Mutation frequency, physical mutagens, ionizing radiations and non-ionizing radiations, radiosensitivity. Chemical mutagens - mutagenic compounds, mode of action, molecular basis of mutation. In vitro site-directed mutagenesis. **DNA Repair Mechanism**: DNA damage, dark repair, light repair, post-replication repair, SOS repair systems. Mobile genetic elements in eukaryotes, transposon tagging of genes, genetics and evolutionary significance. **Regulation of Gene Expression in Prokaryotes**: Operon models - Lac operon inducible system, cap protein and catabolite repression, His operon repressible system, Trp operon attenuation control. Post-transcriptional control - feedback inhibition and protein degradation. **Regulation of Gene Expression in Eukaryotes**: Short-term regulation, heat shock proteins, activators, enhancers, and silencers. Hormonal regulations, DNA methylation, Z-DNA. Molecular control of transcription, gene expression, and chromosome organization, euchromatin and heterochromatin, and gene amplification. Role of RNA in gene expression: siRNA, antisense RNA, hairpin RNA, and RNAi.	
Unit-IV	**15 Hours**
Genome Organization: Genome size, cot analysis, DNA constancy and enigma. DNA complexity, coding and non-coding sequences, LINES and SINES and multigene families. **Genomics**: Introduction, structural genomics - cytogenetic maps, FISH, SNP, STR, AFLP, RFLP, RAPD, mapping quantitative traits using QTL, construction of chromosome-specific library, positional cloning - chromosome walk and jumps. **Functional Genomics**: Gene expression sequences, DNA microarray and genome evolution.	

A2GEN002P. MOLECULAR BIOLOGY (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 12	DSC 12	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Isolate and quantify genetic material from various sources

CO2: Perform mutagenesis and mutant characterization

CO3: Learn regulation of gene expression by substrates

1. Isolation of genomic DNA from plants,
2. Isolation of genomicDNA from microbes
3. Isolation of genomic DNA from mammals.
4. Quantification of DNA by UV-spectrophotometer.
5. Agarose gel electrophoresis and quality check of isolated DNA.
6. Isolation and quantification of RNA by UV-spectrophotometer.
7. Electrophoresis of RNA using denaturing gels.
8. Induction and characterization of mutations using chemical/physical mutagens in plants
9. Induction and characterization of mutations using chemical/physical mutagens in Microbes
10. Induction and demonstration of heat shock proteins.
11. Mutation and DNA repair system in microorganisms.
12. Substrate induced enzyme synthesis in *E. coli*.

(New experiments may be introduced each year)

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11. *Molecular and Cellular Methods in Biology and Medicine*, P.B. Kaufman, W. Wu, D. Kim, and L.J. Cseke, CRC Press, Florida, 1995.
12. *DNA Science: A First Course in Recombinant Technology*, D.A. Mickloss and G.A. Freyer, Cold Spring Harbor Laboratory Press, New York, 1990.

A2GEN003T: INTERMEDIARY METABOLISM (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 13	DSC 13	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Understand the bioenergetics principles

CO2: have an insight of metabolism of biomolecules

CO3: Learn the regulation of signal transduction

Syllabus Course 13 (Theory):INTERMEDIARY METABOLISM	**Total Hours: 60**
Unit-I	**15 Hours**
Bioenergetics: Free energy change in biological transformations, thermodynamic principles in biology, redox potential, high energy compounds, brief account of enzymes and coenzymes involved in biological oxidations, organization of respiratory electron transport system, mechanism of oxidative phosphorylation, biological energy transducers, chemiosmotic generation of ATP. **Metabolism of Carbohydrates**: Glycolysis, Citric acid cycle, glyoxylate cycle, gluconeogenesis, pentose phosphate pathway, glycogenolysis and glycogen synthesis, biosynthesis of lactose and starch. Energetics and regulations of the pathways.	
Unit-II	**15 Hours**
Metabolism of Amino Acids: Hydrolysis of proteins, proteases, biosynthesis of amino acids and their catabolism (deamination, decarboxylation, transamination). Coordinated control of amino acid metabolism, formation of ammonia and urea, nitrogen cycle, biological nitrogen fixation (symbiotic and non-symbiotic). **Metabolism of Lipids**: Lipid hydrolysis, lipases, outlines of schemes of oxidation of fatty acids (saturated and unsaturated), biosynthesis of fatty acids, biosynthesis of cholesterol, phospholipids and glycolipids, leukotrienes and eicosanoids, prostaglandins and thromboxanes. Lipid peroxidation, metabolism of ketone bodies. Regulation of lipid metabolism.	

Unit-III	**15 Hours**
Metabolism of Heme: Biosynthesis and degradation of heme porphyrin, regulation, porphyries. **Metabolism of Nucleotides**: Biosynthesis of purine and pyrimidine nucleotides by de novo and salvage pathways. Regulation inhibitors of nucleotide biosynthesis. Degradation of nucleotides. **Signal Transduction**: Inter and intra cellular signalling: Signal molecules - Protein and non-protein signals. Organisms involved in the synthesis and release, transport, target cells/tissues. Signal receptors, distribution interaction between the signal receptors, signal transducing elements, and the mechanism of transduction. Role of second messengers, such as calcium, cAMP, cGMP, phosphatidyl inositol phosphatases. A general view of plant signals, phytohormones, calcium, phosphatidyl inositol, and their mechanisms.	
Unit-IV	**15 Hours**
Photosynthesis: Introduction, photosynthesis pigments, photosystems, cyclic and non-cyclic electron flow and photophosphorylation, CO2 fixation by Calvin Cycle, C3, C4 and CAM pathways, photorespiration. **Biochemistry of Hormones**: Classification, structure and functions of hormones. Biosynthesis of steroid hormones, thyroid hormones, hormone receptors, second messengers, signal transduction, signal component receptors, mechanism of signal transduction.	

A2GEN003P: INTERMEDIARY METABOLISM (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 14	DSC 14	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: identify carbohydrate by semimicro qualitative analysis

CO2: isolate and purify biomolecules from its source

CO3: quantify biomolecular concentration in a given sample

1. Qualitative analysis of carbohydrates.
2. Qualitative analysis of proteins.
3. Qualitative analysis of amino acids.
4. Qualitative analysis of lipids.
5. Estimation of mineral elements (Na/P/K/Ca/Fe).
6. Constructive of maltose calibration curve
7. Determination of salivary amylase activity.
8. Analysis of inhibition of salivary amylase activity
9. Extraction and estimation of Thiamine or Niacin
10. Extraction and estimation of Ascorbic acid or Vitamin A.
11. Estimation of lycopene.
12. Estimation of Chlorophyll
13. Estimation of plant hormone - IAA / Ethylene.

(New experiments may be introduced each year)

References:

1. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D., and Darnell, J. (2000): *Molecular Cell Biology*, W.H. Freeman and Co.
2. Voet, D., and Voet, J. (2000): *Biochemistry*, John Wiley and Sons.
3. Stryer, L. (2000): *Biochemistry*, 5th Ed., W.H. Freeman and Co., New York.
4. Moran, L.A., Sceimgeour, K.G., Horton, H.R., Ochs, R.S., and Rawn, J.D. (2003): *Biochemistry*, 3rd Ed., Neil Patterson Publishing, Prentice Hall.

5. Lehninger, A. (2000): *Principles of Biochemistry*, C.B.S. Publishers.
6. Mathews, C.K. and Van Holde, K. (1996): *Biochemistry*.
7. S. Sadavasivam and A. Manikam (1992): *Biochemical Methods for Agricultural Sciences*, Wiley Eastern Ltd, New Delhi.
8. Jayaraman, J. (1968): *Laboratory Manual for Biochemistry*, Wiley Eastern Ltd, New Delhi.
9. Plummer, D.T. (1977): *An Introduction to Practical Biochemistry*, Tata McGraw Hill, Bombay.
10. Dr. Palanivelu (2001): *Analytical Biochemistry and Separation Techniques - A Laboratory Manual for B.Sc. and M.Sc. Students*.

A2GEN201T: RECOMBINANT DNA TECHNOLOGY AND MOLECULAR CLONING (Theory)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC 1	OEC 1	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the basic principles of genetic engineering

CO2: understand the principles of gene cloning and transfer

CO3: learn the methods gene expression analysis in transgenics

Syllabus OEC -1 (Theory):RECOMBINANT DNA TECHNOLOGY AND MOLECULAR CLONING	**Total Hours: 60**
Unit-I	**15 Hours**
Cloning Basics: Cloning, Overview of the procedure, Gene library, Hybridization, molecular cloning, construction of DNA library, Library screening, Expression libraries, Restriction mapping, RFLP, DNA sequencing. **Purification and Separation of nucleic acids:**Extraction and Purification of nucleic acids, Detection and Quantitation of Nucleic acids, Gel Electrophoresis. **Cutting and Joining DNA:**Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules.	
Unit-II	**15 Hours**
Vectors: Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors : YACs and BACs. **Amplifying DNA:** PCR and Cell based DNA Cloning – The importance of DNA Cloning, PCR : basic features and application, Principles of Cell-based DNA Cloning, Cloning System for amplifying different sized fragments, Cloning System for producing single-stranded and mutated DNA.	

Nucleic Acid Hybridization: Principle and application - Preparation of nucleic acid probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays, and microarrays.	
Unit-III	**15 Hours**
Gene Recombination and Gene transfer : Bacterial Conjugation, Transformation, Transduction, Episomes, Plasmids, Microinjection, Electroporation, Microprojectile, Shot Gun method, Ultrasonication, Liposome fusion, Microlaser. **Mutation:** Site-directed mutagenesis and Protein engineering: Primer extension for site directed mutation, PCR based site directed mutagenesis, Random mutagenesis, Use of Phage display techniques to facilitate the selection of mutant peptides, Gene shuffling, production of chimeric proteins.	
Unit-IV	**15 Hours**
Analyzing gene expression: (a) Reporter Genes - Commonly used reporter genes, Analysis of gene regulation Purification and detection tags. **Analysis at the level of gene transcription**: Northern blot, in situ hybridization, Rnase protection assay, RTPCR. **Analysis at the level of Translation:** Western blot, in situ analysis, ELISA, protein gel electrophoresis, Antibody production.	

References:

1. Strickberger, M.W. (1995). *Genetics*, 3rd Edn., Prentice-Hall Inc., London.
2. Tamrin, R.M. (2000). *Principles of Genetics*, 6th Ed., W.M.C. Brown Publications Co., London.
3. Snustad, D.P., & Simmons, M.J. (2003). *Principles of Genetics,* 3rd Edn., John Wiley & Sons Inc., N.Y.
4. Alberts, B., Bray, D., Lewin, J., Raff, M., Roberts, K., & Watson, J.D. (1994). *Molecular Biology of The Cell*, 3rd Edn.
5. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D., & Darnell, J. (2000).

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6. Kaip, G. (1996). *Cell and Molecular Biology: Concept and Experiments*, John Wiley & Sons Inc., N.Y.

THIRD SEMESTER
A3GEN001T: GENETIC ENGINEERING (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 15	DSC 15	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the concepts of genetic engineering

CO2: Have an insight about the tools and techniques in molecular cloning

CO3: learn the principles of Biohazards and biosafety regulations in genetic engineering

SyllabusCourse 15(Theory):GENETIC ENGINEERING	**Total Hours: 60**
Unit-I	**15 Hours**
General Introduction to the Concept of Genetic Engineering: Milestones in genetic engineering; isolation of enzymes, DNA sequencing: synthesis and mutation, detection and separation, cloning, gene expression. Patenting of life forms, genetic engineering guidelines. **Restriction Endonucleases**: Modification, methylases, and other enzymes needed in genetic engineering. **Cloning Vectors**: Plasmids and plasmid vectors, phages and phage vectors, phagemids, cosmids, artificial chromosome vectors (YAC, BAC, HAC), animal virus-derived vectors - SV40 and retroviral vectors.	
Unit-II	**15 Hours**
Molecular Cloning: Recombinant DNA techniques, construction of genomic DNA and cDNA libraries, screening of recombinants. Expression strategies for heterologous genes. **DNA Analysis**: Labeling of DNA and RNA probes. Southern blotting and fluorescence in situ hybridization, DNA fingerprinting, chromosome	

walking.	
Unit-III	**15 Hours**
Analysis of Gene Expression: Northern and Western blotting, gel retardation technique, DNA footprinting, primer extension, S1 mapping, reporter assays, RT-PCR, and microarray. **DNA Sequencing**: Chemical synthesis of oligonucleotides; techniques of in vitro mutagenesis, site-directed mutagenesis, gene replacement, and gene targeting. Polymerase chain reaction (PCR) and its applications.	
Unit-IV	**15 Hours**
Use of Transposons in Genetic Analysis:Transposon tagging, transposon engineering and its use in identification and isolation of genes and functional analysis. **Applications of Genetic Engineering**: Transgenic animals, production of pharmaceuticals, gene therapy, disease diagnosis. **Biosafety Regulation**: Biosafety, Biohazard, Physical and biological containment.	

A3GEN001P: GENETIC ENGINEERING (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 16	DSC 16	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: prepare competent cells for genetic transformation

CO2: clone the gene in suitable vector and transform in to the host

CO3: analyze the gene product

1. Bacterial culture and antibiotic selection media.
2. Preparation of competent cells.
3. Isolation of plasmid DNA.
4. Quantification of plasmid DNA.
5. Agarose gel electrophoresis and restriction mapping of DNA.
6. Construction of restriction map of plasmid DNA.
7. Cloning in plasmid vectors.
8. Preparation of single-stranded DNA template.
9. DNA sequencing.
10. Gene expression in *E. coli* and analysis of gene product.
11. Amplification of GAPDH gene
12. Expression analysis genes by RTPCR
13. Reporter gene assay (GUS/CAT/a-GAL).
14. Gene silencing (Demonstration using a teaching kit).

(New experiments may be introduced each year.)

References:

1. Molecular Cloning: A laboratory manual, J. Sambrook, E.F. Fritsch, and T. Maniatis. Cold Spring Harbor Laboratory Press, New York, 2000.
2. DNA Cloning: A practical approach, D.M. Glover and B.D. Hames, IRL Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W.Wu, D. Kim, and L.J. Cseke, CRC Press, Florida, 1995.

A3GEN002T: MICROBIAL GENETICS AND TECHNOLOGY (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 17	DSC 17	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Understand the principles of metabolic regulation in microbes

CO2: Understand basics of reproduction and recombination in microbes

CO3: Have an insight about genetic improvement of microbes for industrial applications

Syllabus Course 16(Theory):MICROBIAL GENETICS AND TECHNOLOGY	**Total Hours: 60**
Unit-I	**15 Hours**
Metabolic Regulation in Bacteria: Microbial metabolism, catabolism, EMP, PP, ED, PK pathways; TCA cycle, respiration, and fermentation. Anabolism-biosynthesis of nucleic acids, proteins, peptidoglycan, and lipids. Metabolic regulation: Modification of enzyme activity, control of enzyme synthesis, mechanism of general regulation. Secondary metabolism and its control, non-ribosomal peptide synthesis, auto regulation, end-product regulation, nitrogen and phosphate regulation. Use of metabolic inhibitors and tracer techniques in the investigation of metabolic pathways. **Mutagenesis in Bacteria**:Isogenic strains, types of mutants—auxotrophic and antibiotic mutants; mutagenic agents and mechanism of action of mutagens; isolation and characterization of mutants, replica plating; reversion and suppression.	
Unit-II	**15 Hours**
Plasmid Biology: Types of plasmids, isolation and purification of plasmid DNA, transfer of plasmid DNA, in vitro plasmid transfer, plasmid replication. **Transposable Genetic Elements**: IS elements, detection of transposition, transposition mechanism, and excision of transposons, phage mu, transposition and evolution. **Recombination in Bacteria**: Transformation biology, molecular mechanisms, transformation mapping, and other applications. Conjugation—F-factor, Hfr transfer, and mapping. Recombination in recipient cells, Rec mutants—properties, Rec protein and function.	

Unit-III	15 Hours
Phagegenetics: Phage genetic material, phage mutants. T4 phage and its life cycle. Genetic recombination and mapping in T4 phage Lambda phage-gene organization, lytic cycle, transcription,replicationandrecombinationinlambdaphageandnonessentialgenes.Lysogeny-immunityandexcisionandothermodesoflysogeny.Lambdaphageand carcinogen screening. **Finestructureanalysisofgene:** One gene one enzyme hypothesis. Argenine biosynthesis in *Neurospora*, colinearity between gene and protein Tryptophan synthase gene in *E.Coli*.Genetic analysis of rII region of T4 phage and cistronconcept.	
Unit-IV	**15 Hours**
Geneticimprovementofindustrialmicroorganisms: Screening selection and genetic improvementofindustrialculture.Mutationandscreening-randomandrational screening.Use of recombinant DNA technology in SIP. Problem associated with SIOP. Improvement of character other than product.Importance of media in SIP. **Industrialfermentation:**Industrialfermentationandproductionoforganicacids, aminoacids,antibiotics,alcohol,enzymes,polymers,biomass,solvents,steroidsand vitamins. Recent advances in industrial products using microbes: Biosensors, biochips, biofertilizers, bioplastic and bioremediation, immobilized cells and enzymes.	

A3GEN002P: MICROBIAL GENETICS AND TECHNOLOGY (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 18	DSC 18	Practical	2	4	56	3	10	40	50

Total Hours: 56 hours

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: induce mutation and characterize mutants

CO2: to carry out the recombination in bacteria

CO3: to ferment the raw material to prepare value added products

1. Induction and characterization of mutants in bacteria.
2. UV-dose survival curve in bacteria.
3. Diauxic growth curve in bacteria
4. Conjugation in bacteria.
5. Isolation of plasmid.
6. Isolation of bacterial RNA
7. Transduction in bacteria
8. Microbial fermentation.
9. Isolation of DNA from Soil
10. Bacterial typing by 16s typing
11. Fungal typing by ITS sequences
12. Microbiological assay of vitamins.
13. Isolation of microbial lipids and transesterification.
14. Microbiological quality analysis of water

(New experiments may be introduced each year.)

References:

1. Maylor,S.R.,Cronan,J.E.,Freifelder,D.(1994):MicrobialGenetics2ndEdn.Jonesand Bartlett Pub. Boston.
2. Hayes,W.(1968):Geneticsofbacteriaandtheirviruses,2ndEd.JohnWileyandSons N.Y.
3. Dale.J.W.(1994):Moleculargeneticsofbacteria,2ndJohnWileyandSonsN.Y.
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5. Glazer,A.N.,andNikaido,H.(1995):MicrobialBiotechnology,W.H.FreemanN.Y.
6. Stanbury,P.F.andWhitaker,A.(1984):PrinciplesoffermentationTechnology, Pergamon Press Ltd. London.
7. Dale, J.W. (1994). *Molecular genetics of bacteria*, 2nd ed. John Wiley and Sons, N.Y.
8. Glazer, A.N., and Nikaido, H. (1995). *Microbial Biotechnology*, W.H. Freeman, N.Y.

A3GEN003T: HUMAN GENETICS AND GENETIC COUNSELLING (THEORY)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 19	DSC 19	Theory	4	4	60	2	20	80	100

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the pattern of inheritance of genes and its effect on human health

CO2: have an insight of techniques used in disease diagnosis

CO3: understand the principles of genetic counselling

Syllabus course 19(Theory):HUMAN GENETICS AND GENETIC COUNSELLING	Total Hours: 60
Unit-I	15 Hours
Meaning and Scope of Human Genetics: Historical development of human genetics. Its relationship with other biological sciences and medicine. **Patterns of Monogenic Inheritance**: Pedigree construction, autosomal inheritance, sex-linked inheritance. Other modes of inheritance—mitochondrial genes, genomic imprinting, uniparental disomy. **Patterns of Polygenic and Multifactorial Inheritance**: Continuous and discontinuous traits, multifactorial threshold traits, pyloric stenosis, neural tube defect, congenital heart defects. Complex disorders of adult life.	
Unit-II	15 Hours
Human Cytogenetics: Normal human karyotype, sex chromosomes, chromosome preparation methods—leucocyte culture, bone marrow, solid tissue, testicular and ovarian biopsies. Chromosome banding methods and nomenclature of chromosome bands. Autosomal abnormalities—abnormalities of chromosome number and structure. Sex chromosomal abnormalities. **Gene Mapping and Linkage Analysis**:Physical mapping of human genes—somatic cell genetics, mapping by gene dosage, FISH, and high-resolution mapping approaches. Detection and measurement of linkage in humans.	
Unit-III	15 Hours

Biochemicalgenetics: Biochemical and molecular basis of human diseases. Inborn errors of metabolism- amino acid, carbohydrate and nucleic acid metabolisms. Haemoglobinopathies- globin gene mutation and genetic disorders. Lysosomal and other genetic disorders. **GeneticsofCancer:** Forms of cancer, genetic basis and properties of cancer cells, clonalnature,oncogenes,tumorsuppressorgenes.Familialcancer,cancercytogenetics,chemical and radiation carcinogenesis.	
Unit-IV	15 Hours
AppliedHumanGenetics: Preventionandcureofhereditarydiseases:prenataldiagnosis and preimplantation diagnosis, amniocentesis, chorion villi sampling, ultrasonography, cytogenetic and biochemical analysis Genetic screening of hereditary diseases, gene therapy. DNA fingerprinting and paternity diagnosis. Eugenics. **Molecular Diagnostics:** Nucleic acid and Protein based Diagnostics, Genetic and Cytogenetic diagnostics, advantages, short comings and future perspectives **GeneticCounseling:** Meaning, Objectives and goals. Process of genetic counselling, diagnosis, family historycalculatingtherisk,discussingtheoptions,genetictesting of children, carrier detection, ethical and legal aspects	

A3GEN003P: HUMAN GENETICS AND GENETIC COUNSELLING (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 20	DSC20	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: detect inborn errors of metabolism

CO2: identify chromosomal defects in humans

CO3: learn the methods of genetic counselling

1. Detection of inborn errors of metabolism.
2. Identification of ABO and Rh blood group alleles.
3. Estimation of hemoglobin.
4. Estimation of lipid profile (HDL, LDL, VLDL).
5. Culture of human leucocytes and chromosomal preparations.
6. Human karyotyping.
7. Chromosomal abnormalities in some human syndromes.
8. Cytogenetic characterization of cancerous cells.
9. In vitro fertilization and embryo transfer (demonstration).
10. Genetic counseling methods based on case history.
11. Assessment of inheritance of quantitative characters.
12. Study of sex chromatin in humans.
13. Diagnosis of Human genetic diseases by PCR or RTPCR technique
14. Diagnosis of Human infectious diseases by PCR or RTPCR technique

(New experiments may be introduced each year.)

References:

1. Thompson,M.W.,Mc.Innes,R.R.,Willard,M.F.(1991),5EdnW.B.SaundersandCo. London.
2. ISCN(1995):Aninternationalsystemforhumancytogeneticnomenclature.F. MitlemanKarger, Freiburg.
3. Mange,E.J.andMange,A.P.(1999):BasicHumanGenetics,2Ed.SinauerAssoc.Inc. Mass.
4. Pasternak,S.(2000):Introductiontomolecularhumangenetics,Fritzgarland.
5. Limoine,W.R.andCooperD.NB(1996):GeneTrophy,BiosScientificPub.Oxford.
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7. Conner,J.M.andSmith,MAF(2000):EssentialMedicalGeneticsBlackwellSci.Pub. Oxford.
8. ISCN (1995). *An international system for human cytogenetic nomenclature*, F. Mitleman, Karger, Freiburg.
9. Mange, E.J. and Mange, A.P. (1999). *Basic Human Genetics*, 2nd ed. Sinauer Assoc. Inc. Mass.

10. Pasternak, S. (2000). *Introduction to molecular human genetics*, Fritzgarland.

A3GEN202P: MOLECULAR DIAGNOSIS AND MOLECULAR MEDICINE (THEORY)

Teaching Hours per Week: 4

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
OEC 2	OEC 2	Theory	4	4	60	2	20	80	100

Credits: 4

Total Hours: 60

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand the principles of molecular diagnostics

CO2: understand the principles of molecular medicine

CO3: learn the principles of transgenic animal use in health research

Syllabus OEC 2 (Theory):**MOLECULAR DIAGNOSIS AND MOLECULAR MEDICINE**	Total Hours: 60
Unit-I	15 Hours
Introduction to Molecular Basis of Diagnosis: Discovering human disease genes, cloning human disease genes. Functional and positional cloning of candidate genes. **DNA Diagnostic Systems**: Polymerase Chain Reaction (PCR) techniques, DNA, RNA, and Protein blotting, Reverse line blotting, Hybridization probes, non-radioactive hybridization procedures, molecular beacons, DNA fingerprinting, Single Nucleotide Polymorphisms (SNP), Restriction Fragment Length Polymorphisms (RFLP), Randomly Amplified Polymorphic DNA (RAPD), Padlock probes, genotyping with fluorescence-labeled PCR primers, DNA micro-array.	
Unit-II	15 Hours
Molecular Diagnosis of Genetic Disease: Direct detection of mutations in human disease genes—Single strand conformation, polymorphism analysis, Sensitive conformation gel electrophoresis,	

Denaturing Gradient Gel Electrophoresis, Heteroduplex analysis, Chemical mismatch cleavage, Direct DNA sequencing, Protein truncation test, Linkage analysis.**Examples**: Sickle Cell anemia, Hemophilia, etc.	
Unit-III	15 Hours
Molecular Cytogenetics: Basic principles of FISH, steps in typical FISH procedure, signal amplification procedure, other systems of FISH: Comparative Genomic Hybridization (CGH), Molecular FISH, Primed in situ hybridization (PRINS), and in situ PCR. **Applications of FISH**: Probes hybridizing to unique sequences: Prader-Willi syndrome, Angelman syndrome, translocations. (Probes hybridizing to entire chromosomes): Chromosome painting, chromosome in situ suppression (CISS), reverse painting.	
Unit-IV	15 Hours
Concepts and Perspectives of Molecular Medicine: Basic Biochemistry, Molecular Biology, and Genetics relevant to Molecular Medicine. **Human Genome**: Implications and applications. Gene therapy as a potential tool to cure human diseases. Recombinant molecules in medicine. **Transgenic and Knockout Animal Models**: Stem cell research and its application in human health. Intellectual Property Right (IPR) issues and Ethical, Legal, and Social Issues (ELSI).	

References:

1. Gelehrter R.D., Collins F.S. and Ginsburg D. (1998) Principles of Medical Genetics, Baltimore, Williams and Wilkins
2. KingstonH.(1994)AnABCofClinicalGenetics,London,BMJpublishing.
3. ThompsonM.andMcinnesJ.(1998)GeneticsinMedicine,Philadelphia,Saunders
4. King R.A., Rotter J.I. and Motulsky A.G. (1992) The Genetic Basis of common diseases Oxford, Oxford University Press

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6. StrachanT.andReidA.P(1996)HumanMolecularGenetics,OxfordBios.
7. Trent R.J., (1997) Molecular Medicine an Introductory Text. Edinburg Churchill Livingstone.
8. KrawczakM.andSchmidtkeJ.(1994)DNAFingerprinting,Oxford,Bios

FOURTH SEMESTER
A4GEN001T: BIOINFORMATICS (THEORY)

Teaching Hours per Week: 4
Credits: 4

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course 21	DSC 21	Theory	4	4	60	2	20	80	100

Total Hours: 60

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: know the biological databases and data retrieve principles

CO2: understand the principles multiple sequence alignment and sequence analysis

CO3: understand the concept of protein structure analysis

Syllabus course 21 (Theory):**BIOINFORMATICS**	Total Hours: 60
Unit-I	15 Hours
Information Theory and Biology: Concepts of probability, joint probability, conditional probability. Shannon Entropy and Information, Mutual information, Information theory, Bayes theorem, Markov chains, Hidden Markov Models, applications to DNA and protein sequences. **Biological Databases**:Introduction. Construction, file formats, contents, search and retrieval tools of various biological databases: GenBank, SwissProt, Protein Data Bank, PubMed, Online Mendelian Inheritance in Man, Species 2000, KEGG pathway database, Gene Expression Omnibus, Prosite, BLOCKS, Structural Classification of Proteins (SCOP) Database.	
Unit-II	15 Hours
Pairwise Sequence Alignment and Database Sequence Similarity Search: Meaning of sequence alignment, pairwise sequence alignment, Global alignment, Local alignment, Dynamic Programming Method, Needleman-Wunsch algorithm, Smith-Waterman algorithm, Substitution matrices—Unitary matrix, PAM, and BLOSUM matrices, Gap penalties, Evolutionary basis and significance of sequence alignment. **Sequence Similarity Search Methods** for DNA and protein sequences and their significance: a. FASTA—Algorithm, Parameters, Output, and	

interpretation of results, Versions of FASTA. b. BLAST—Parameters, Output, and interpretation of results, Versions of Algorithm, BLAST. c. PSI-BLAST and PHI-BLAST.	
Unit-III	15 Hours
Multiple Sequence Alignment:Meaning of Multiple Sequence Alignment, Global Multiple Sequence Alignment: Progressive Alignment method CLUSTALW. Local Multiple sequence Alignment: Profile Analysis, Block Analysis. Significance of Multiple Sequence Alignment. Multiple Sequence Alignment editors: JalView, GeneDoc, CLUSTALX, Boxshade. **Molecular Phylogenetics**:Meaning of phylogenetic analysis. Relationship between Multiple Sequence Alignment and Phylogenetic Analysis. Meaning and significance of evolutionary trees. **Methods of phylogenetic prediction:** Distance-based methods—Fitch-Margoliash method, Neighbor joining method, Unweighted Pair Group Method with Arithmetic Mean (UPGMA). Maximum Parsimony method, Maximum Likelihood method.Softwares used for Phylogenetic analysis-PHYLIP and PAUP.	
Unit-IV	15 Hours
Genome Databases and Genome Analysis: Genomic sequence databases: GOLD, human genome sequence database, Mouse Genome database, Arabidopsis genome resource, *E. coli* genome database. **Genome Sequence Analysis**: Principle, salient features, and drawbacks of methods of gene prediction/gene modeling: GRAIL, GENEMARK, GLIMMER. Promoter prediction methods.Salient features and drawbacks of methods of genome comparison: MUMMER. Significance of comparative genomics. **Protein Structure Prediction**: Principle, salient features, and drawbacks of methods of prediction of protein secondary structure: Chou-Fasman, GOR, PSI-PRED, PROF, PHD. Prediction of tertiary structure of proteins: Comparative protein modeling, threading, and ab initio structure prediction.	

A4GEN001P: BIOINFORMATICS (PRACTICAL)

Contact Hours per Week: 4
Credits: 2
Total Hours: 56 hours

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 22	DSC 22	Practical	2	4	56	3	10	40	50

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Know the biological databases and data retrieve principles

CO2: understand the principles multiple sequence alignment and sequence analysis

CO3: Able to understand the concept of protein structure analysis

1. Literature database search: PubMed, Scopus, Web of Science and Cochrane database
2. Database search and retrieval using keywords: GenBank, SwissProt, PDB, OMIM, KEGG, GEO, ProSite, GOLD.
3. Pairwise sequence alignment using GAP and SIM algorithms.
4. Sequence search and retrieval using BLAST.
5. Primer designing using primer 3
6. Sequence search and retrieval using FASTA.
7. Multiple sequence alignment using CLUSTALW.
8. Phylogenetic analysis using PHYLIP or PAUP.
9. Gene prediction using algorithms like GRAIL, GLIMMER, GENEMARK.
10. Genome comparison using MUMMER.
11. Protein structure prediction using algorithms like GOR, PSI-PRED, PROF, PHD.
12. Analysis of ligand binding pockets using online softwares
13. Prediction of ORF using online tools
14. Searching OMIM database

References:

1. Durbin, Eddy, Krogh, and Mitchinson (2004): *Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids*. Allied Publishers.
2. Nucleic Acids Research, Database Issue, Oxford University Press.

3. David W. Mount (2005): *Bioinformatics Sequence and Genome Analysis*, 2nd Edition. Cold Spring Harbor Laboratory Press, USA / CBS Publishers, India.

A4GEN002T: IMMUNOGENETICS AND IMMUNOTECHNOLOGY (THEORY)

Teaching Hours per Week: 4
Credits: 4
Total Hours: 60

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Know the cells and organs of the immune system

CO2: understand the principles antigen-antibody interaction in health and disease

CO3: Able to understand the concept of protein structure analysis

Syllabus course 23(Theory): **IMMUNOGENETICS AND IMMUNOTECHNOLOGY**	Total Hours:60
Unit-I	15 Hours
Introduction: Phylogeny of immune system, innate and acquired immunity, clonal nature of immune response. **Cells and Organs of Immune System**: Hematopoiesis, immune system cells: lymphoid cells, mononuclear cells, granulocytic cells; organs of the immune system, primary and secondary lymphoid organs, B-Cell receptor. **Antigens**: Factors that influence immunogenicity, properties of B-cell epitope and T-cell epitope.	
Unit-II	15 Hours
Immunoglobulin Genes: Genetic model compatible with Ig structure, mutagenic organization of Ig genes, gene arrangements, generation of antibody diversity, expression of Ig genes, regulation of Ig gene transcription. **Immune Response to Infectious Diseases**: Viral, bacterial, and protozoan diseases. Autoimmunity. Immunodeficiency diseases: Phagocytic, humoral, cell-mediated, and combined immunodeficiency.	
Unit-III	15 Hours
Immune Systems and AIDS: The immune system in AIDS, HIV, diagnosis of HIV infection and AIDS, immunological abnormalities in	

AIDS, development of an AIDS vaccine. **Transplantation Immunology**: Immunological basis of graft rejection, MHC and HLA polymorphism tissue typing, general and specific immunosuppressive therapy. **Cancer and Immune System**: Tumors of the immune system, tumor antigens, immune response to tumors, cancer immunotherapy.	
Unit-IV	15 Hours
Immuno-technology: Introduction, production of polyclonal and monoclonal antibodies, engineered antibodies, purification and fragmentation of immunoglobins; immunoprecipitation, labeling antibodies; immunoblotting and immunoassay; immunostaining, immunohistochemistry and immunocytochemistry. **Stem cells:**Introduction, types of stem cells, isolation/ culturing of stem cells and applications of stem cells. **Regenerative medicine:** Principles, procedure, applications, success stories and challenges in regenerative medicine. Ethical Issues associated with stem cell-based regenerative medicine field	

References:

15 Hours

1. Immunology,JanisKuby,3"ed.W.H.FreemanandCo.,(1997)
2. KubyImmunololgy, 4h ed., R.A. Goldsby, Thomas. J. Kindt, Barbara A. Osborne (Freeman)
3. Immunology, A short Course, 4 ed, Eli Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss)
4. FundamentalsofImmunology,WilliamPaul.
5. ImmunologybyRoittandothers.
6. Gordon, J.R. (1998). *A Practical Guide to Cellular and Molecular Methods in Immunology*. Gordon Publishers.
7. Sell, S. ed., 2013. Stem cells handbook. Springer Science & Business Media.
8. Stocum, D.L., 2012. Regenerative biology and medicine. Academic Press.
9. Meyer, U., Meyer, T., Handschel, J. and Wiesmann, H.P. eds., 2009. Fundamentals of tissue engineering and regenerative medicine. Springer Science & Business Media.

A4GEN002P: IMMUNOGENETICS AND IMMUNOTECHNOLOGY (PRACTICAL)

Course No	Type of course	Practical/Theory	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative Assessment Marks	Total Marks
Course No 24	DSC 24	Practical	2	4	56	3	10	40	50

Total Hours: 56 hours

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Immunization and collection of serum

CO2: Purification of antibodies

CO3: Isolation of PBCs and monocytes

1. Blood film preparation and identification of cells.
2. Lymphoid organs and their structured organization.
3. Immunization of laboratotyanimalscollection of serum.
4. Double diffusion and immuno-electrophoresis.
5. Radial immunodiffusion.
6. Purification of IgG from serum.
7. Testing for Typhoid antigens by Widal test
8. Separation of mononuclear cells by Ficoll-Hypaque method.
9. Con-A induced proliferation of thymocytes (by MIT method).
10. Western blotting of HIV samples (Demonstration)
11. Detection of pathogens by byELISA.
12. . Isolation of pheripheral blood mononuclear cells.
13. Isolation of monocytes from blood.
14. Immunodiagnostics (demonstration using commercial kits).

(New experiments may be introduced each year.)

References:

1. Sam-Yellowe, T.Y., Sam-Yellowe, T.Y. and Sam-Yellowe, T., 2021. Immunology: Overview and laboratory manual (pp. 105-116). Switzerland: Springer.

2. Turgeon, M.L., 2020. Immunology & Serology in Laboratory Medicine-E-Book: Immunology & Serology in Laboratory Medicine-E-Book. Elsevier Health Sciences.
3. Immunology,JanisKuby,3"ed.W.H.FreemanandCo.,(1997)
4. KubyImmunololgy, 4h ed., R.A. Goldsby, Thomas. J. Kindt, Barbara A. Osborne (Freeman)
5. Immunology, A short Course, 4 ed, Eli Benjamin, Richard Coico, Geoffrey Sunshine (Wiley-Liss)
6. FundamentalsofImmunology,WilliamPaul.
7. ImmunologybyRoittandothers.
8. Gordon, J.R. (1998). A Practical Guide to Cellular and Molecular Methods in Immunology. Gordon Publishers.

A4GEN003T: GENETICS OF CROP IMPROVEMENT (THEORY)

Total Teaching Hours:60
Teaching hours per week:4
No. of credits:4

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: understand centres of origins of crop plants

CO2: understand plant propagation and breeding techniques

CO3: know the principles of transgenic plant production

Unit I

Introduction: Objectives of plant breeding, Activities in plant breeding. Centres of origin of crop plants, Germplasm conservation- in situ seed banks, plant banks, shoot tip banks, cell and organ banks, DNA banks, germplasm evaluation- cataloguing- multiplication and distribution

Plant introduction: History of plant introduction- primary and secondary, plant introduction agencies. Procedure of plant introduction –quarantine- cataloguing- evaluation – multiplication distribution – acclimatization, purpose of plant introduction, merits and demerits.

Mode of reproduction: Sexual Reproduction- Monoecious and dioecious plants, Floral Morphology, Pollination (self and cross), fertilization. Vegetative reproduction – different methods- grafting, layering, apomixis- classification with examples

15Hours

Unit II

Incompatibility: Definition, different types – self incompatibility- sporophytic homomorphic and heteromorphic incompatibility – gametophytic and incompatibility, mechanism of self incompatibility, pollen- stigma interaction, pollen tube -style interaction, pollen tube -ovary interaction –significance of self incompatibility, methods to overcome self incompatibility- bud pollination, surgical methods and off season pollination, high temperature, irradiation

Sterility: male sterility – genetic male sterility - cytoplasmic male sterility – cytoplasmic genetic male sterility, application in crop improvement

Selection: History of selection, purelineselection , mass selection, pedigree selection, bulk method of selection, merits and demerits.

Selection by Back Crossing: Introduction, requirements, applications of back cross methods, Consequences of backcross, procedure of back cross method - transfer of a dominant gene, transfer of a recessive gene, selection of the characters being transferred, transfer of quantitative characters.

15Hours

Unit III

Plant Breeding: Breeding for Designer oils and biodiesel, plant secondary products, designer flowers,

plants as bioreactors, vaccines, plantibodies, and bioplastics. Using molecular biology to probe plant physiological processes- prospects of engineering RUBISCO and nitrogenfixation

Hybridization: History , techniques and consequences, objectives , types of hybridization – interspecific, intergeneric, distant hybridization, procedure of hybridization, choice of parents, evaluation of parents, emasculation – different methods, bagging, tagging, pollination , harvesting and storing of the F1 seeds and selfing, consequences of hybridization.

15Hours

Unit IV

Methods of gene transfer to plants: Protoplast fusion, organelle engineering. Recombinant vector techniques: Non-integrative DNA transfer- Caulimoviruses, Geminiviruses, plant RNA viruses, Cornybacterial plasmids. Integrative DNA transfer- Agrobacterium Ti and Ri plasmids, Agroinfection, homologous DNA and transposons as vector.

Transgenics: First commercial transgenic plants- transgenic tomatoes, control of ripening by antisense technology, insect resistance (Bt. protein), golden rice, herbicide resistance.

Genome Editing: Crop improvement by Homologous Recombination, CRISPR/Cas9 Tools, Transcription activator-like effectors nucleases (TALENs), Virus-Induced Gene Silencing (VIGS), Zinc finger nucleases (ZFNs), Base Editors and Pentatricopeptide Repeat Proteins.

15Hours

References:

1. Chopra,V. L. 2000. Plant Breeding. Theory and Practicals edition),Oxford& IBH Publ. Co. Pvt.. Ltd., New Delhi.
2. Frankel, R &Galum, E.1977. Pollination Mechanisms, Reproduction and Plant Breeding. Springer-Verlag, Berlin/ Heidelberg/ NewYork.
3. Jain H.K. &Kharkwal, M.C..(Eds.) 2004. Plant Breeding: Mendelian to Molecular Approaches.-. Narosa Publishing. House, New Delhi, Chennai, Mumbai, Calcutta.
4. Poehlman, J.M & David.A.S.1995. Field Crops (4th edition). Panima Publ. Co., New Delhi/ Bangalore.
5. Poehlman, J.M. & Borthakur, D. 1959. Breeding Asian Field Crops with Special Reference to Crops of India. Oxford & IBH Publishing Co. New Delhi, Bombay, Calcutta.
6. Jain, S.M., Brar, D.S. and Ahloowalia, B.S. eds., 2010. Molecular techniques in crop improvement. Dordrecht, TheNetherlands:: Springer.
7. Upadhyay, S.K. ed., 2021. Genome engineering for crop improvement (pp. 1-394). Wiley.
8. Slafer, G. A. (2021). Genetic improvement of field crops. CRC Press.
9. Al-Khayri, J. M., Sattar, M. N., Sopory, S. K., & Jain, S. M. (Eds.). (2024). Genome Editing for Crop Improvement: Theory and Methodology.
10. Pazhamala, L. T., Kudapa, H., Weckwerth, W., Millar, A. H., & Varshney, R. K. (2021). Systems biology for crop improvement. The plant genome, 14(2), e20098.

A4GEN003P: GENETICS OF CROP IMPROVEMENT (PRACTICAL)

Contact Hours per Week: 4
Credits: 2
Total Hours: 56 hours

Course Outcomes: After successful completion of the course, the student will be able to,

CO1: Perform the techniques in plant propagation

CO2: Perform the techniques in plant breeding

CO3: learn the basics of transgenic creation

1. Multiplication of plants by gooting
2. Multiplication of plants by shoot cutting, suckers and runners
3. Grafting for plant propagation
4. Budding for plant propagation
5. Shoot tip culture
6. Sterilization techniques- Emasculation
7. Pollen collection and germination
8. Pollen viability test
9. Demonstration of pollination (self and cross)
10. Isolation of plant DNA
11. Detection transgenic gene in plants
12. Detection of Bt Protein in cotton
13. Isolation of nif genes
14. Agrobacterium mediated transformation in plants

(New experiments may be introduced each year.)

References:

11. Jain, S.M., Brar, D.S. and Ahloowalia, B.S. eds., 2010. Molecular techniques in crop improvement. Dordrecht, TheNetherlands:: Springer.
12. Upadhyay, S.K. ed., 2021. Genome engineering for crop improvement (pp. 1-394). Wiley.
13. Slafer, G. A. (2021). Genetic improvement of field crops. CRC Press.
14. Al-Khayri, J. M., Sattar, M. N., Sopory, S. K., & Jain, S. M. (Eds.). (2024). Genome Editing for Crop Improvement: Theory and Methodology.
15. Pazhamala, L. T., Kudapa, H., Weckwerth, W., Millar, A. H., & Varshney, R. K. (2021). Systems biology for crop improvement. The plant genome, 14(2), e20098.
16. Allard, R.W.1960. Principles of Plant Breeding. John Wiley & Sons. Inc. New

York. Backcock., E.B. 2001
17. Genetics and Plant breeding. Agrobios (India), Jodhpur
18. Basra, A. S.2000.Heterosis and hybrid seed production In Agronomic Crops (Basra, A.S. Ed.). M.S. Swaminathan Research Foundation, Taraman Industrial Area, Chennai.
19. Bose, T.K., Mitra S.K. & Sadhu, M.K.1986. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prakash, Calcutta.
20. Briggs,F.N& Knowles, P.F 1967. Introduction to Plant Breeding. Reinhold Publ. Co., New York/ Amsterdam/ London.

A4GEN004P: PROJECT WORK

• Students will be able to search the literature and identify the research gapto select the research problem.

Students will be able to frame the objectives to address the problem identified

• They will be learning to adopt/ develop the experimental procedure suitable for their laboratory setup and infrastructure

• Students will develop observation, data analysisand interpretation skills to approach the research solutions

• They will be able to write the scientific reports and present in appropriate scientific meetings.

• Student will able to prepare the manuscript and publish their research findings the journals of National/International repute.

Students will be working under the guidance of suitable and qualified research supervisor for the period of a semester (IV semester). The project work also may be allotted to the students in previous semesters as per the necessity with respect to time required and complexity of the research problem