KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ

ಸ್ವಾತಂತ್ರ್ಯದ ಅಮೃತ ಮಹೋತ್ಸವ

Tele: 0836-2215224
e-mail: academic.st@kud.ac.in
Pavate Nagar,Dharwad-580003
ಪಾವಟೆ ನಗರ, ಧಾರವಾಡ – 580003

NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/JS/MGJ(Gen)/2024-25/ 612 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 ಅನುಮೋದನೆ ದಿನಾಂಕ: 27/07/2024

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ, 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 ಅನುಮೋದಿತ ಪದವಿಗಳ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಬಿತ್ತರಿಸಲಾಗಿದೆ. 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 / ಗೌಪ್ಯ / 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. Genetics

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 N E P (Revised):2024

Karnatak University, Dharwad

B.Sc.in Genetics

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
								Formative	Summative	Total	
I	DSC-1	Theory	C1GEN1T1	Cytogenetics	04hrs	60	03 hrs	20	80	100	04
	DSC-2	Practical	C1GEN1P1	Cytogenetics Practicals	04 hrs	56	03 hrs	10	40	50	02
II	DSC-3	Theory	C2GEN1T1	Mendelian genetics	04hrs	60	03 hrs	20	80	100	04
	DSC-4	Practical	C2GEN1P1	Mendelian genetics Practicals	04 hrs	56	03 hrs	10	40	50	02
III	DSC-5	Theory	C3GEN1T1	Molecular Biology of the Gene	04hrs	60	03 hrs	20	80	100	04
	DSC-6	Practical	C3GEN1P1	Molecular Biology of the Gene Practicals	04 hrs	56	03 hrs	10	40	50	02
IV	DSC-7	Theory	C4GEN1T1	Molecular Genetics	04hrs	60	03 hrs	20	80	100	04
	DSC-8	Practical	C4GEN1P1	Molecular Genetics Practicals	04 hrs	56	03 hrs	10	40	50	02
*V	DSC-9A	Theory	C5GEN2T1	General Genetics	04hrs	60	03 hrs	20	80	100	04
	DSC-10A	Practical	C5GEN2P1	General Genetics Practicals	04 hrs	56	03 hrs	10	40	50	02
	DSC-9B	Theory	C5GEN2T2	Biostatistics and Bioinformatics	04hrs	60	03 hrs	20	80	100	04
	DSC-10B	Practical	C5GEN2P2	Biostatistics and Bioinformatics Practicals	04 hrs	56	03 hrs	10	40	50	02
*VI	DSC-11A	Theory-	C6GEN2T1	Adavanced Genetics	04hrs	60	03 hrs	20	80	100	04
	DSC-12A	Practical	C6GEN2P1	Adavanced Genetics Practicals	04 hrs	56	03 hrs	10	40	50	02
	DSC-11B	Theory-	C6GEN2T2	Genetic Engineering	04hrs	60	03 hrs	20	80	100	04
	DSC-12B	Practical	C6GEN2P2	Genetic Engineering Practicals	04 hrs	56	03 hrs	10	40	50	02
V	EC-1	Theory	C5GEN5T1	Introduction to Bell Biology	03hrs	45	03 hrs	20	80	100	03
VI	EC-2	Theory	C6GEN5T1	Molecular Biology Techniques	03hrs	45	03 hrs	20	80	100	03
IV/V/VI **	Skill	Practical	C0GEN6P1	Applied Genetics Practicals	04 hrs	56	03 hrs	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. Genetics

Programme Specific Outcomes (PSO):

On completion of the 03 years Degree in Genetics students will be able to:

- Demonstrate, solve and understand the major concepts in all the disciplines of Genetics.
- 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 Genetics
- 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 Genetics.
- 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.
- The Program offers both classical as well as modern concepts of Genetics in higher education. enables the students to study genetic diversity in both local and global environments.
- To update the concepts concerning genetic diversity among different traits of population, patternofinheritance.
- To correlate contemporary and modern techniques like genomics, metagenomics, genome editingandmolecular diagnostic tools. Bioinformatics and computational tools used in modern sciences will provide ample opportunitiestoexplore different career avenues and provide opportunity to

B.Sc. Semester – I

Discipline Specific Course (DSC)-1

Course Title: CYTOGENETICS

Course Code: C1GEN1T1

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

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

CO1: Understand the cell structure

CO2: Have insight of Cell organelles and their functioning

CO3: Know concept of chromosome number and their variation

CO4: Understand the use of tools and techniques used in cytogenetics

CO5: Have insight of cellular reproduction and its importance

Unit	Title: CYTOGENETICS	60 hrs/ sem
Unit I	**Introduction and History:** Cytology and Genetics. Cell as a basic unit of life, Prokaryotic and eukaryotic cell **Microscopy:** Principle, Construction, and Applications – Dissecting, Compound, Phase contrast, Fluorescent, Electron, Inverted microscopes. **Fixatives and Stains:** Different types of fixatives and stains, composition, preparation and applications	15 hrs
Unit II	**Ultrastructure of Cell:** Chemical composition, structure and functions of cell organelles – Cell wall, Plasma membrane, Endoplasmic reticulum, Centrosomes, Lysosomes, Peroxisomes, Ribosomes, Vacuoles, Cytosol, Golgi complex, Plastids, Mitochondria, Nucleus (Nuclear envelop, pore complex, chromatin and nucleolus), Cytoskeleton (Microtubules, Microfilaments, and Intermediate filaments). Cell inclusions **Chromosomes:** Size, Number, Structure, and Classification. **Karyotype and Evolution.**	15 hrs
Unit III	**Topography of Chromosomes:** Ultrastructure of DNA, Chemical composition, DNA packaging, and significance. **Chromosomal aberrations:** Structural (Deletion, Duplication, Inversions, and Translocations), Numerical (Euploidy, Aneuploidy, auto and allopolyploidy). Practical and evolutionary significance. **Special type chromosomes** – Giant, salivary gland, and supernumerary chromosomes. Practical and Evolutionary significance.	15 hrs

Unit IV	**Cell Reproduction:** Cell cycle –Different phases (G0, G1, S, G2, and M), check points, and significance. Cell Division - Mitosis and Meiosis (in plants and animals) Significance of cell division. Cancer and Apoptosis **Gametogenesis**: Plants (microsporogenesis and megasporogenesis) and animals (spermatogenesis and oogenesis)	15hrs

Recommended books:

1. Cell and Molecular Biology, 2nd Edition, P.K. Gupta (2003). Rastogi, Meerut.
2. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis. Saunder College.
3. Cell Biology by C.B. Powar Himalaya Publication.
4. Plant Cell Biology: Structure and Function: Jones and Bartlett, Boston.
5. Cytology by Cibas Edmund S. Fourth Edition. Elsevier Health Sciences
6. Cytology Genetics and Molecular Genetics by PANDEY, McGraw Hill
7. Textbook of Cytology by P.S.Varma and V.K.Agarwal. S.Chand Publishers
8. Essentials of Cytology by C.B. Powar. Himalaya Publishers
9. Cell Biology, Genetics and Biotechnology by N. Arumugam, Saras Publication

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)-2

Course Title: Cytogenetics Practical

Course Code: C1GEN1P1

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

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

CO1: Understand the cell structure

CO2: Have insight of Cell organelles and their functioning

CO3: Know concept of chromosome number and their variation

CO4: Understand the use of tools and techniques used in cytogenetics

CO5: Have insight of cellular reproduction and its importance

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. General laboratory rules, maintenance of laboratory, Hazards and safety measures.
2. Handling of microscopes and demonstration with onion peeling.
3. Preparation of different stains and other chemicals.
4. Mitosis: Preparation and observation of different stages in onion root tips.
5. Mitosis: Preparation and observation of different stages in *Aleo vera* root tips.
6. Symmetric karyotype analysis in onion
7. Asymmetric karyotype analysis in *Aloe vera*
8. Meiosis: Preparation and observation of different stages in onion flower buds.
9. Calculation of Chiasma frequency.
10. Meiosis : Preparation and observation of different stages in *Rheo* flower buds.
11. Identification of translocation heterozygotes
12. Identification of B chromosomes Maize
13. Identification of B chromosomes *Trigonella*
14. Study of evolution of Polyploid wheat

Books recommended:

1. Singh, R.J., 2017. *Practical manual on plant cytogenetics*. CRC press.
2. Das, D., 2017. *Essential practical handbook of cell biology & genetics, biometry & microbiology: a laboratory manual*. Academic Publishers.
3. Sharma, A. and Sharma, A., 2014. *Chromosome techniques: theory and practice*. Butterworth-Heinemann.
4. Arsham, M.S., Barch, M.J. and Lawce, H.J. eds., 2017. The AGT cytogenetics laboratory manual. John Wiley & Sons.
5. Ordoñez, B., Orrillo, M. and Bonierbale, M.W., 2017. Technical manual potato reproductive and cytological biology.
6. Windham, M.D., Pryer, K.M., Poindexter, D.B., Li, F.W., Rothfels, C.J. and Beck, J.B., 2020. A step-by-step protocol for meiotic chromosome counts in flowering plants: A powerful and economical technique revisited. Applications in Plant Sciences, 8(4).
7. Dutta, U., 2022. Essentials of Cytogenetic and Molecular Cytogenetic Laboratory Testing. Cambridge Scholars Publishing.
8. Mahmoudi, S. and Mirzaghaderi, G., 2023. Tools for drawing informative idiograms. In Plant Cytogenetics and Cytogenomics: Methods and Protocols (pp. 515-527). New York, NY: Springer US.

B.Sc. Semester – II

Discipline Specific Course (DSC)-3

Course Title: MENDELIAN GENETICS

Course Code: C2GEN1T1

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

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

CO1: Understand the origin and development of science of genetics

CO2: Learn the Mendelian concepts and their applications

CO3: Have an insight of violations in Mendelian concepts of genetics and its applications

CO4: Understand and prepare cytogenetic maps

CO5: have the idea of sex determination of plants and the animals

CO6: Undestand the lifecycle and other basics about model organism in genetic studies

Unit	Title: - MENDELIAN GENETICS	60 hrs/ sem
Unit I	**Introduction and history;** Pre-Mendelian, Mendelian, and post-Mendelian genetics. **Mendelism:** Basic Principles and Mendel's experiments with pea plants. Monohybrid and dihybrid crosses, Law of dominance, Law of Segregation and Law of independent assortment. Test cross and back cross. Incomplete dominance and simple problems. **Extension of Mendelism**: Interaction of genes: Interallelic and Intraallelic, Incomplete dominance, Co-dominance, Multiple Alleles and Multiple allele Confer Drug Resistance in the Malaria Parasite, pleotropism, polygenic traits, lethal genes. Penetrance-Expressivity. Dominance	15 hrs
Unit II	**Extension of Mendelism:II** Complementary gene interaction (Example:Lathyrus Odoratus), Supplementary gene Interaction (Grain colour in Maize) Epistatis – Dominant Epistasis (Example: Cucurbeta Pepo), Recessive epistasis (Example: Coat colour in mice), Non- Epistasis (Comb Patern in Paultry) and hypostasis and Sex linked traits. Application of Mendelian Principles in humans. **Gene Concepts:** Genes, alleles and, pseudoalleles, Complementaton test- Cistron, muton and recon.	15 hrs

Unit III	**Linkage and crossing-over:** **Linkage:** Discovery, theories, Types, linkage groups and significance. Construction of linkage maps in eukaryotes. **Crossing Over:** Discovery, Characters, types, factors affecting, mechanism and significance. Difference between and linkage and crossing over. Two point Cross and Three point cross. X-linkage in *Drosophila*. **Sex determination:** Different types of sex-determinations: Sex-linked, sex-influenced and sex-limited characters. Chromosomal basis of sex-determination in *Drosophila* and Humans. Dosage compensation – Lyon hypothesis, Sex determination mechanism in plants. Extra-chromosomal inheritance: Uniparental inheritance in Chlamydomonas, maternal inheritance in snails, cytoplasmic inheritance in Neurospora, petite mutants in yeast. and plastid system, mitochondrial inheritance in humans and Biparental inheritance in *Pelargonium*.	15 hrs
Unit IV	**Life-cycle of model organisms**: Viruses- TMV, Bacteriophage and Lambda Phages; Bacteria - *E. coli*; Fungi- Yeast, *Neurospora*; Paramecium; *Ceonorhabdites*; *Drosophila*, *Arabidopsis*.	10hrs

Recommended books:

1. Atherly A. G., J.R. Girton and J.F. Me. Donald. 1999. The Science of Genetics. Saunders College Publishing, Harcourt Brace.College Publishers. NY.
2. Gardner E.J ., M.J. Simmons and D.P. Snustad. 1991 , Principles of Genetics, John Wiley and Sons, Inc. NY.
3. Griffiths A.J.F., J. H. Miller., D.T. Suzuki., R.C. Lewontin and W.M. Gelbart, 1996. An Introduction to Genetic analysis, V. H. Freeman and Company, New York.
4. Snustad D.P. and M.J. Simmons, 1997, Principles of Genetics, John Wiley and Sons, Inc. NY.
5. Principles of genetics VI th Edn. by Robert H. Tamarin, McGraw-Hill Publications. Fundamentals of Genetics by R.P. Meyyan, Saras Publication
6. Genetics - 9th Edition by V. K. Aggarwal and P. S. Verma. S. Chand Pub. Cell Biology Genetics Molecular Biology Evolution and Ecology by P. S. Verma. S. Chand Pub.

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 – II

Discipline Specific Course (DSC)-4

Course Title: MENDELIAN GENETICS Practical

Course Code: C2GEN1P1

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

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

CO1: Learn handling and culturing *Drosophila* for genetic studies

CO2: Breed the *Drosophila* for genetic analysis.

CO3: To solve the problems based on genetic principles

CO4: Prepare and observe special chromosomes

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1) Floral Structure of Pea Plant, Maize and Arabidopsis.
2) Culture, technique and handling of fruit fly.
3) Morphology and life cycle of fruit fly.
4) Mounting of sex comb in *D. melanogaster*: Normal characters, , genital plate, wing structure.
5) Mounting of sex comb in *D. melanogaster*.
6) Mounting of genital plate in *D. melanogaster*.
7) Observation of mutants in drosophila.
8) Study of wing structure in normal and mutant *melanogaster*.
9) Separation of pigments in drosophila eye color mutants by paper chromatography
10) Study of polytene chromosomes in *Drosophila* larvae.
11) Study of polytene chromosomes in *Chaironomus* larvae.
12) Solving genetic problems related to monohybrid and dihybrid crosses with examples in plants and animals.
13) Solving genetic problems related to with multiple alleles, interaction of genes and sex linked inheritance
14) Solving problems in Genetics: Linkage analysis in plants and animals

Books recommended:

1. Perveen, F.K., 2018. Introduction to drosophila. Drosophila melanogaster: model for recent advances in genetics and therapeutics, p.3̃.
2. Faria, V.G. and Sucena, É., 2017. From nature to the lab: Establishing Drosophila resources for evolutionary genetics. *Frontiers in Ecology and Evolution*, *5*, p.61.
3. Trigunayat, M.M. and Trigunayat, K., 2019. A Manual of Practical Zoology: Biodiversity, Cell Biology, Genetics & Developmental Biology Part-1. Scientific Publishers.
4. Graf, U., Van Schaik, N. and Würgler, F.E., 2012. *Drosophila genetics: A practical course*. Springer Science & Business Media.
5. Roote, J. and Prokop, A., 2013. How to design a genetic mating scheme: a basic training package for Drosophila genetics. *G3: Genes| Genomes| Genetics*, *3*(2), pp.353-358.
6. Wilson, L., Matsudaira, P.T., Goldstein, L.S. and Fyrberg, E.A., 1995. *Drosophila melanogaster: practical uses in cell and molecular biology*. Academic Press.
7. Stocker, H. and Gallant, P., 2008. Getting started: an overview on raising and handling Drosophila. *Drosophila: methods and protocols*, pp.27-44.
8. Chyb, S. and Gompel, N., 2013. *Atlas of Drosophila Morphology: Wild-type and classical mutants*. Academic Press.

B.Sc. Semester – III

Discipline Specific Course (DSC)-5

Course Title: - MOLECULAR BIOLOGY OF GENES

Course Code:C3GEN1T1

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-5	**Theory**	**04**	**04**	**60 hrs.**	**3hrs.**	**20**	**80**	**100**

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

CO1: Know the milestones in molecular biology

CO2: Have an insight of genetic material and its composition across the life forms

CO3: Understand the mechanisms governing central dogma of molecular biology

CO4: the principle and application of techniques used in molecular biology

Unit	Title: MOLECULAR BIOLOGY OF GENES	60 hrs/ sem
Unit I	**Introduction :** History, Development and Relation to other fields **Hereditary Material:** DNA-as genetic material: Discovery of transformation in Bacteria, experimental proof that DNA mediates transformation, proof that DNA stores genetic information in Bacteriophage T2; experimental proof that RNA stores the genetic information in some viruses. Structure of DNA: Chemical composition, Watson and Crick model, types of DNA, pro and eukaryotic DNA, extra nuclear DNA, functions of DNA.	15 hrs
Unit II	**Structure of RNA:** RNA- Chemical composition, structure of mRNA, tRNA, rRNA and SnRNA, functions of RNA. **DNA Synthesis:** Brief account of cell cycle, concept of C-value enigma, methods of DNA replication, Meselson-Stahl experiment, enzymes required for DNA replication in pro and eukaryotes. **RNA Synthesis:** Enzymes involved in RNA synthesis, transcription, post-transcriptional modifications.	15 hrs
Unit III	**Genetic Code:** Discovery, Flow of genetic information, types of RNA, Codon concept, important features, initiator and terminator codons. Genetic Code Dictionary of RNA, Wobble hypothesis, Evolution of Genetic Code **Proteins and protein synthesis:** Composition, structural organization, classification and functions. Protein synthesis: translation- initiation, elongation and termination, post-translational modifications.	15 hrs

Unit IV	**Molecular organization of genes:** Split genes, Mobile genetic elements in Bacteria, Drosophila, Maize and Humans. **Genomics and proteomics:** Genomic Tools- Electrophoresis, Restriction Mapping, Polymerase Chain Reaction, Reverse transcription DNA Sequencing, Practical Benefits from Gene Cloning; Proteomic tools: SDS PAGE, 2D electrophoresis	15hrs

Recommended books:

1. Benjamin Lewin 2005 : Genes VIII, Oxford University Press, Oxford.
2. Stanley R. Maloy, John E. Cronan, Jr., David Frecjfeldar 1994: Microbial Genetics. Jones and Vartlett Publishers, Boston.
3. Gunther S . Stent and · Richard Calender, 2002 : Molecular Genetics , CBS publishers and distributors.
4. Gerald Karp 2002 : Cell and Molecular Biology, Concepts and experiments. John Wiley and Sons, Inc. N.Y.
5. Gupta P. K. 2005 : Cytogenetics, Rastogi Publication

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 – III

Discipline Specific Course (DSC)-6

Course Title: MOLECULAR BIOLOGY OF GENES Practical
Course Code: C3GEN1P1

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

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

CO1: Learn the techniques used in microbial isolation and basic handling

CO2: Isolate and purify nucleic acids from different sources

CO3: Manipulation of nucleic acid for molecular biological analysis

CO4: construct basic map of DNA

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1) Study of different bacterial media.
2) Preparation of L.B Medium.
3) Preparation of EMB agar medium
4) Isolation of soil bacteria by serial dilution
5) Study of colony morphology
6) Isolation of E. coli from sewage sample
7) Study of antibiotic sensitivity in *E. coli*
8) Bacterial staining.
9) Study of bacterial growth curve of *E. coli* DH5ά. using Spectrophotometer.
10) Localization of DNA.
11) Isolation of Plasmid DNA.
12) Restriction of plasmid DNA and separation of agarose gel
13) Isolation of *E. coli* Phages
14) Construction of restriction map of circular DNA

Recommended books:

1. Aneja, K.R., 2007. *Experiments in microbiology, plant pathology and biotechnology*. New Age International.

2. Pepper, I.L., Gerba, C.P. and Brendecke, J.W., 1995. *Environmental microbiology: a laboratory manual*. Academic Press.
3. Dubey, R.C. and Maheshwari, D.K., 2002. *Practical Microbiology, 4/e*. S. Chand Publishing.
4. Davis, L., 2012. *Basic methods in molecular biology*. Elsevier.
5. Schleif, R.F. and Wensink, P.C., 2012. *Practical methods in molecular biology*. Springer Science & Business Media.
6. Jain, A., Jain, R. and Jain, S., 2020. *Basic techniques in biochemistry, microbiology and molecular biology* New York, NY, USA:: Springer.
7. Green, M.R. and Sambrook, J., 2012. *Molecular cloning. A Laboratory Manual 4th Edn*. CSHL Press.

B.Sc. Semester – IV

Discipline Specific Course (DSC)-7

Course Title: - MOLECULAR GENETICS
Course Code: C4GEN1T1

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

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

CO1: Have insight of mutations and their biological effect
CO2: Know genetic basis of selected model organisms and their exploitation in genetic experiments
CO3: Have an idea of genetic basis recombination and its application
CO4: Learn the regulation of gene expression in eukaryotes and prokaryotes

Unit	Title: MOLECULAR GENETICS	60 hrs/ sem
Unit I	**Mutation:** Historical account, chromosomal and gene mutations, spontaneous and induced mutations, frame shift, and point mutation. Molecular basis of mutation, types of mutations, transition and transversion; reverse mutations, non-sense mutations, mutagens- physical and chemical, DNA damage and repair mechanisms. Significance of mutations and examples.	15 hrs
Unit II	**Bacterial Genetics:** Bacterial chromosome and its structure. Plasmids and their genetic constitution, Conjugation transformation and transduction in bacteria. Gene mutation in bacteria. Bacteriophages, Transposable genetic elements, Gene transfer technology, Bacterial chromosome, gene mapping. **Genetics of Viruses:** Discovery, origin, structure, virulence and pathogenecity, Types of viruses, mapping of phage genome. T4 phage, TMV, HIV, Covid-19. Plant and animal viral diseases.	18 hrs
Unit III	Genetic Recombination: Physical basis of recombination, molecular basis of general recombination and site specific recombination, enzymes involved in recombination: chromosome mapping, recombination and evolution	12 hrs
Unit IV	**Gene Regulation: In prokaryotes-** inducible and repressible gene regulation, positive and negative control of gene expression; operon concept- Lac-operon, Trp-operon, His operon. **In Eukaryotes-** spatial and temporal regulation of gene expression, environmental and biological factors, molecular control of transcription, translational and post-translational control of gene expression and chromosome organization, gene silencing, and inactivation of chromosome.	15hrs

Recommended books:

1. Watson J.D., N.H. Hopkins, J. W. Roberts; J. A. Steitz and A.M. ·Weiner, 1987 : *Molecular Biology of Genes. The Benjamin* Cummings Publishing Company, Inc., Tokyo.
2. Atherly A. G., *J.* R. Girton and J. F. Me Donald 1999 : *The Science of Genetics*. Saunders College Publishing., Harcourt Brace College Publishers, N.Y.
3. Brooker J. 1999: *Genetics: Analysis and Principles*. Benjamin Cummings, Longman Inc .
4. Fairbanks D. J. and W. R. Anderson, 1999 : *Genetics - The continuity of life*. Brooks/Cole publishing Company ITP., N.Y. Toranto.
5. Gtiffiths A. J. F., J. H. Miller, D. T. Suzuki, R . C. Lewontin and W. M. Gelbert . 1996: *An introduction to Genetic analysis* W . H. Freeman and Company, N.Y.
6. Gupta P. K. 2004 : *Genetics*. Rastogi Publishers.

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 – IV

Discipline Specific Course (DSC)-8

Course Title: MOLECULAR GENETICS Practical
Course Code: C4GEN1P1

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

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

CO1: Understand the mechanism of lateral gene flow in microbes

CO2: Perform the chemical induced mutagenesis in plants

CO3: Screening transformants for genetic manipulation

CO4: have an insight of mutations and their phenotypic effect

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Study of conjugation in bacteria (3 Practicals).
2. Study of barr body.
3. Study of effect of mutagens on plants. (2 Practicals)
4. Preparation of competent cells (2 Practicals)
5. Transformation of plasmid DNA in *E. coli* DH5ά.
6. Screening of transformants (Blue white screening)
7. Observation of mutant Drosophila flies.
8. Preparation of flies and Induction of Heat shock Protein in *Drosophila*
9. Induction of Heat shock Protein in *E. coli* DH5ά.

Books recommended**:**

1. Green, L.H. and Goldman, E. eds., 2021. *Practical handbook of microbiology*. CRC press.
2. Green, M.R. and Sambrook, J., 2012. *Molecular cloning. A Laboratory Manual 4th Edn*. CSHL Press.
3. Schleif, R.F. and Wensink, P.C., 2012. *Practical methods in molecular biology.* Springer Science & Business Media.
4. Giri, C.C. and Giri, A., 2013. *Plant biotechnology: practical manual*. IK International Pvt Ltd.

B.Sc. Semester – V

Discipline Specific Course (DSC)-9A

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

Course Title: GENERAL GENETICS

Course Code:C5GEN2T1

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

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

CO1: Understand the effect of genes on behaviour
CO2: Concept of genome organization
CO3: Have insight of genetic control of development
CO4: An insight of population genetic structure
CO5: Application of genetic principles for genetic improvement of crops

Unit	Title: GENERAL GENETICS	60 hrs/ sem
Unit I	**Genes and Behaviour:** Genetic analysis of behaviour in experimental animals-Nest cleaning behaviour in honey bee. Biological rhythms in Drosophila and Mice, Sexual preference in Drosophila, Nutritional behavior in mice, Chemotaxis in E. Coli. Chromosomal abnormalities and insights into Human behavior. Single gene mutations and human behavior- phenylketonuria, Lesch-Nyhan syndrome, Huntington's disease, Complex human behavior-intelligence, personality.	15 hrs
Unit II	**Genome organization:** Differences between pro- and eukaryotic genomes, genome size in eukaryotes, Evolutionary complexity, C-value enigma, genome size diversity and significance, Repetitive DNA- LINES, SINES, heterochromatin, Special types chromosomes-Giant, Lamp brush and B-chromosomes. Centromere and telomere, Extra-chromosomal genomes- Plasmid, Cosmid, mitochondria and chloroplast. **Developmental genetics-I:** **Genes in development and differentiation:** Genetic analysis of development in model organisms like Drosophila, Ceonorhabdits and Arabidopsis	15 hrs
Unit III	**Developmental genetics-II:** **Molecular analysis of genes involved in development:** Maternal gene activity in development- determination of dorso-ventral and posterio-anterior axes in Drosophila embryos, Zygotic gene activity in development. **Quantitative genetics:** Quantitative traits in plants and animals. Multiple factor hypothesis, polygenic inheritance, role of environment in quantitative inheritance, components of genetic variance, estimation of genetic variance, heritability, heterosis, inbreeding depression, out-breeding, line-breeding.	15 hrs

Unit IV	**Population genetics and evolution:** Darwinism and Neo-Darwinism with an emphasis on Hardy-Weinberg law of genetic equilibrium and exceptions: The evolutionary forces which can alter them- Natural selection, Random genetic drift and speciation. A brief account of Human evolution. **Application of Genetic principles in plant and animal improvement:** Selection and breeding programs for productivity. Biotic and abiotic stresses which affect plant growth and productivity. Breeding for disease resistance, stress tolerance, Draught tolerance.	15hrs

Recommended books:

1. Atherly A.G., J.R. Girton and J. F. McDonald, 1999. *The Science of Genetics.* Saunders College Publishing., Harcourt Brace College Publishers N.Y.
2. Brooker R.J. 1999. *Genetics; Analysis and Principles.* Benjamln/Cummmings Longman Inc.
3. Griffith .A.J.F., J.H .Miller., D.T.Suzuki .,R.C.Lewontin and W.M.Gelbert. 1996. *An introduction to Genetic Analysis*. W.H.Freeman and Company. N.Y.
4. Snustad D.P and M.J. Simmons. 1997. *Principles of Genetics*, John Wiley and Sons, Inc. N.Y.

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 – V

Discipline Specific Course (DSC)

Course Title: General Genetics Practical

Course Code: C5GEN2P1

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

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

CO1: Prepare the karyogram and ideogram for genetic analysis

CO2: Understand the concept of allele frequency variation in natural population experimentally

CO3: To study chromosome organization and variation by basic banding techniques

CO4: Understand chemotaxis in cells by hand on experimentation

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Root tip squash preparation and preparation of permanent slides (4 Practicals).
2. Karyotype analysis and chromosome evolutionary studies.
3. Study of inheritance of PTC in Human and pedigree analysis.
4. Identification of blood group
5. Calculation of allelic frequencies.
6. Pedigree analysis in human with simple Mendelian traits.
7. Chromosome banding pattern in *Onion*
8. Chromosome banding pattern in *chaironomous* larvae.
9. Glucose induced chemotaxis in bacteria.

Books recommended:

1. Hall, B.K. and Hallgrímsson, B., 2011. *Strickberger's evolution*. Jones & Bartlett Publishers.
2. Maloy, S.R., 1990. *Experimental techniques in bacterial genetics*. Jones & Bartlett Learning.
3. Arsham, M.S., Barch, M.J. and Lawce, H.J. eds., 2017. *The AGT cytogenetics laboratory manual*. John Wiley & Sons.
4. Celis, J.E. ed., 2006. *Cell biology: a laboratory handbook* (Vol. 1). Elsevier.
5. Singh, R.J., 2016. *Plant cytogenetics*. CRC press.

B.Sc. Semester – V

Discipline Specific Course (DSC)-9B

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

Course Title: BIOSTATISTICS AND BIOINFORMATICS

Course Code:C5GEN2T2

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

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

CO1: Understand the principles of biostatistics
CO2: Perform basic bioinformatics calculations
CO3: Have insights about bioinformatic tools
CO4: perform basin Bioinformatic analysis of sequences and molecules

Unit	Title: BIOSTATISTICS AND BIOINFORMATICS	60 hrs/ sem
Unit I	**Introduction to Biostatistics and Bioinformatics:** Basic concepts, central tendency, measures of Biology and statistics. Definition and applications of correlation, Linear regression and Chi-square test and dispersion, goodness of fit, students t- test and test for homogeneity. **Definition of Probability:** Law of probability, discrete and continuous, distribution, binomial Poisson and normal distribution.	15 hrs
Unit II	**Parametric and Non-parametric test:** Introduction to one sample binomial or sign test, analysis of variance, one way analysis, two way analysis, degree of freedom for ANOVA.	15 hrs
Unit III	**Biological databases:** Introduction to database concept DNA sequence databases- GenBank, EMBL and DDBJ; Protein sequence databases- SWISS-PROT, UniProt, Prosite; Struture databases-PDB and SCOP, Literature databases.	15 hrs
Unit IV	**Sequence analysis:** Similarity search- BLAST algorithm, Sequence alignment- scoring of alignments and matrices. Pair-wise and multiple sequence alignments. Phylogenetic analysis. **Genomics and Proteomics Tools:** Restriction Analysis –NEBCUTTER. Gene-finding -Genescan, ORF finding-NCBI ORF finder, Protein structure-visualization-Rasmol, Cn3D; Protein structure prediction.	15hrs

Recommended books:

1. Bioinformatics computing-Bryan,l MD. Pearsons Education.
2. Bioinformatics- C.S.V. Murthy, Himalaya Publishing House.
3. Introduction· to Bioinformatics-Attwood and Parry-Smith, Pearson Education. Asia.
4. D.J.Finney (1978): Statistical Methods in Biological Assays, Charles Griffics & Co.
5. A.P.Gore and S.A. Paranjpe (2000): A course in Mathematical & Statistical Ecology, Kluwer.
6. R.C.Elandt Johnson (1975): Probability Models and Statistical Methods in Genetics Wiley.
7. C.C.Li (1976): First course in Population Genetics, Boxwood Press.

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 – V

Discipline Specific Course (DSC)-10B

Course Title: BIOSTATISTICS AND BIOINFORMATICS Practical

Course Code: C5GEN2P2

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

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

CO1: Carryout basic statistical calculation using biological data

CO2: Search nucleic and protein sequences in biological database

CO3: Annotate sequences using bioinformatic tools

CO4: to analyse the data for having insight of basic evolutionary trends

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Calculation of Central tendencies
2. Analysis of data by Chi square test and T test
3. Analysis of Variance calculation using biological data
4. Searching gene and genome using DNA database
5. Searching Protein sequence and structure using protein databases
6. Sequence Similarity searching using BLAST.
7. Multiple Sequence & alignment using Clustal-W.
8. Restriction analysis using NEBCUTTER.
9. ORF finding using NCBI ORF-finder.
10. Protein structure visualization using Cn3D.
11. Protein structure visualization using Cn3D.
12. Reterive of genetic diseases information in OMIM
13. Study of Model Organism Databasis
14. Drawing dendrograms using raw data

Books recommended:

1. Le, C.T. and Eberly, L.E., 2016. *Introductory biostatistics*. John Wiley & Sons.

2. Antonisamy, B., Premkumar, P.S. and Christopher, S., 2017. *Principles and Practice of Biostatistics-E-book: Principles and Practice of Biostatistics-E-book.* Elsevier Health Sciences.
3. Elmore, J.G., Wild, D., Nelson, H.D. and Katz, D.L., 2020. *Jekel's Epidemiology, Biostatistics and Preventive Medicine E-Book: Jekel's Epidemiology, Biostatistics and Preventive Medicine E-Book.* Elsevier Health Sciences.
4. Banerjee, P.K., 2007. *Introduction to biostatistics (a textbook of biometry)*. S. Chand Publishing.
5. Krawetz, S.A. and Womble, D.D. eds., 2003. *Introduction to bioinformatics: a theoretical and practical approach*. Springer Science & Business Media.
6. Xiong, J., 2006. *Essential bioinformatics*. Cambridge University Press.
7. Hernandez, C.A., 2015. Practical Bioinformatics: A Course for the Life Sciences.

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: ADVANCED GENETICS

Course Code:C6GEN2T1

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

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

CO1: Have insights of immune system and its genetic regulation

CO2: Understand the basics of Human genetics

CO3: Understand principles of molecular diagnosis.

CO4: Have insights of breeding methods for crop improvement

Unit	Title: ADVANCED GENETICS	60 hrs/ sem
Unit I	**Immunogenetics:** The immune response; An overview, components of mammalian immune system. Structure and types of antibodies, antibody genes, antibody diversity, histocompatibility genes, monoclonal antibodies, autoimmune diseases. **Cancer Genetics:** Genetic basis of cell-cycle, types of cancer, properties of cancerous cells. Oncogenes: Tumor-inducing retroviruses and viral tumor suppressor genes; pRB, p53, pAPC, phMSH2 etc, Genetic pathway of cancer molecular basis of cancer, theories on cancer.	15 hrs
Unit II	**Human Genetics:** Historical background, Mandelian disorders, dominant and recessive gene disorders, inborn errors of metabolism, chromosome based disorders-autosomal and sex chromosomal disorders. Genetic screening and pedigree analysis. Human genome project, Eugenics., Karyotyping and its significance, C-,G-,Q-Banding techniques and their applications in detecting human cytogenic disorders. Aneuploid analysis in Humans. **Disease and Diagnosis :** Prenatal and Postnatal diseases	15 hrs
Unit III	**Plant genetics and Plant breeding:** Objectives of selection, Mass selection, Progeny selection, Recurrent selection, Clonal selection merits and demerits. Methods of asexually propogated crops. Hybridization- Interspecific and intergeneric hybridization. **Breeding methods for crop improvement:** Disease resistance-concepts, genetics of pathogenecity, disease development, disease escape, mechanisms of disease resistance, genetic asis of disease resistance, sources of disease resistance, breeding methods for disease resistance. Insect-resistance: Nature of insect resistance, genetics of insect resistance, sources of resistance, Breeding methods for insect resistance.	15 hrs

Unit IV	**Polyploidy in plant breeding:** Numerical chromosomal changes- classification. Aneuploidy- Morphological and cytological features, application in plant breeding. Autopolyploidy- origin and production, morphological and cytological features. Segregation in autotetraploids- role in evolution, limitations, application in plant breeding. Allopolyploids-origin and production, morphological and cytological features-role in evolution, limitations, in applications in crop improvement.	15hrs

Recommended books:

1. Atherly, A.G., J.R.Girton and J.F.Mc Donald, 1999, The Science of Saunders College Publishing, Harcourt Brace College Publishers. N.Y.
2. Brooker R.J. 1999, Genetic Analysis and Principles, Benjamin/Cummings;Longman Inc.
3. Griffith A.J.F., J.H.Miller., D.T.Suzuki., R.C.Lewontin andW.M.Gelbert. 1996. An Introduction to Genetic Analysis. W.H.Freeman and Company. New York.
4. Snaustad D.P. and M.J.Simmonss 1997, Principles of Genetics, John Wiley and Sons Inc. NY.
5. Lewin. B.2000. Gene VII. O xford University Press, Oxford New York, Tokyo.
6. Watson J.D, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 1987. Molecular Biology of Genes. The Benjamin/Cummings Publishing Company. Inc.,Tokyo.
7. Lodish A. Berk, S.L.Zipursky, P.Mastsudaira, D.Baltimore and J Damell 1999. Molecular Cell Biology. W.H.Freeman and 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 – VI

Discipline Specific Course (DSC)-12A

Course Title: ADVANCED GENETICS Practical

Course Code: C6GEN2P1

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

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

CO1: Understand basic principles of plant tissue culture

CO2: Perform hybridization methods for plant improvement

CO3: understand application of tissue culture for synthetic seed preparation

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Plant tissue culture technique: Seed, stem, apical bud, anther (6 Practicals)
2. Micropropagation of plants.
3. Synthesis of artificial seeds.
4. Hybridization methods Gooting, Grafting Budding (3 Practicals)
5. Pollen viability test.
6. Compulsory study tour will be conducted to visit premier research institutions. The tour report (a part of the class records) carries 10 marks.

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: Genetic Engineering

Course Code: C6GEN2T2

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

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

CO1: Understands basics of genetic engineering

CO2: Tools and techniques used in genetic engineering

CO3: Application of genetic engineering in animal plant improvement

Unit	Title: Genetic Engineering	60 hrs/ sem
Unit I	**Introduction and key concepts of Recombinant DNA technology:** Cloning and expression vectors: Plasmids- types, classification and general characters. Cloning vectors based on bacterial plasmids, Bacteriophage vectors for E.coli, cosmids, virus vectors for animal cells, vectors for plant cells, Mu chromosomes, YAC, BAC, HAC. Transposons- Binary and Shuttle vectors.	15 hrs
Unit II	**Restriction endonucleases and other DNA modifying enzymes:** Restriction endonuclease- types nomenclature, classsifications, target sites, nature of cut, applications of REN in genetic engineering, DNA modifying enzyme ligases, alkaline phosphatase, polynucleotide kinase, termin deoxynucleotidyl transferase, SI Nuclease, DNA polymerases, RNase, DNase reverse transcriptase., etc. **Gene isolation and cloning:** Isolation of total cellular DNA, Nucleic acid hybridization, construction of rDNA, products-Isolation of human insulin.	15 hrs
Unit III	**Basic Molecular Biology Techniques:** Polymerase Chain Reaction (PCR), Electrophoresis, RFLP, RAPD, DNA sequence in Autoradiography and Southern blotting. DNA fingerprinting and applications.	15 hrs
Unit IV	**Applications of genetic engineering in plant and animal improvement:** Plant tissue culture, somaclonal variations, isolation of haploids, transgenic plants. Animal cloning, transgenic animals. Bacterial genetically modified bacteria for human insulin. Socio-biological and ethical issues of genetic engineering: Concepts of Intellectual property right and patenting.	15hrs

Recommended books:

1. Atherly, A.G., J.R.Girton and J.F.Mc Donald, 1999, *The Science of Genetics.* Saunders College Publishing, Harcourt Brace College Publishers. N.Y.
2. Brooker R.J. 1999, *Genetic Analysis and Principles*, Benjamin/Cummings;Longman Inc.
3. Griffith A.J.F., J.H.Miller., D.T.Suzuki., R.C.Lewontin andW.M.Gelbert. 1996. *An Introduction to Genetic Analysis*. W.H.Freeman and Company. New York.
4. Snaustad D.P. and M.J.Simmonss 1997, *Principles of Genetics,* John Wiley and Sons Inc. NY.
5. Lewin. B.2000. *Gene VII.* O xford University Press, Oxford New York, Tokyo.
6. Watson J.D, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 1987. *Molecular Biology of Genes.* The Benjamin/Cummings Publishing Company. Inc.,Tokyo.
7. Lodish A. Berk, S.L.Zipursky, P.Mastsudaira, D.Baltimore and J Damell 1999. *Molecular Cell Biology.* W.H.Freeman and 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 –VI

Discipline Specific Course (DSC)-12B

Course Title: Genetic Engineering Practical

Course Code: C6GEN2P2

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

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

CO1: Isolate and quantify Nucleic aids from animals and plants

CO2: Analyse the DNA by restriction analysis

CO3: Principle and application of Agarose gel electrophoresis

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Isolation of Plant DNA
2. Isolation of Animal DNA.
3. Purification and estimation using UV-Spectrophotometer (2 practicals).
4. Agarose gel electrophoresis of DNA
5. Isolation of Animal RNA.
6. Agarose gel electrophoresis of RNA
7. Restriction analysis of DNA.
8. Agarose gel electrophoresis of restriction endonuclease digests.
9. Compulsory study tour will be conducted to visit premier research institutions. The tour report (a part of the class records) carries 10 marks.

B.Sc. Semester – V

Elective Course (EC)- EC1

It is for other combination students

Course Title: -Introduction to cell biology

Course Code: C5GEN5T1

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

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

CO1: Understand the basics of cell biology
CO2: Get insight of tools used for cell structure study
CO3: Get the structural and functional insights of cell organelles
CO4: Understand the cell cycle and its regulation

Unit	Title: Introduction to cell biology	45 hrs/ sem
Unit I	**Microscopy -** Introduction, and history, Principle and Optical Components. Types of microscopes - Simple and Compound microscopes. Fluorescence, electron microscopy (transmission and scanning), Phase contrast, Confocal, inverted, Stereo microscopy, application in biological sciences. **Cell membrane and cell wall:** Ultrastructure, chemical composition and functions of Plasma membrane and Plant cell wall. **Ultrastructure and functions of Cytoplasmic organelles**: Chloroplast, Mitochondria, Endoplasmic reticulum, Ribosomes, Lysosomes, Peroxisomes, Golgi bodies, nucleus, and Cytoskeleton.	15 hrs
Unit II	**Cell cycle:** G1, S, G2 and M-phases, Checkpoints and its significance. **Mechanism of Cell Division: Mitosis-** Stages, mitotic apparatus, Karyokinesis and cytokinesis, Mitogens and cell cycle inhibitors, Significance of mitosis. **Meiosis:** Stages, chromosomal synapsis, crossing over, chiasma formation, Synaptonemal complex and significance of meiosis. Spermatogenesis and oogenesis.	15 hrs

Unit III	**Ultra-structure of Eukaryotic Chromosome**: Chromatin and its chemical nature, Centromeric DNA, telomere organization. Chromosome morphology and types, primary and Secondary constriction, SAT-bodies. Macromolecular organization-Nucleosome model and DNA packaging and its importance. Special chromosomes – Salivary gland, lamp brush and accessory chromosomes. C value enigma. **Structural Changes in chromosomes:** Duplications, deletions, inversions and translocations-types, origin, induction and its practical significance. **Numerical changes in chromosomes:** Euploidy-monoploidy, diploidy & polyploidy. Aneuploidy- Hypoploidy (monosomic & nullisomic) and hyperploidy (trisomic and tetrasomic), origin, occurrence, production, cytological behaviour, evolutionary importance and practical applications.	15 hrs

Recommended books:

1. Rastogi V. B. (2014). *Genetics*. KNRN publishers
2. Verma, P. S., & Agarwal, V. K. (2004*). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.* S. Chand Publishing.
3. Hartl, D. L., & Jones, E. W. (2009). *Genetics: analysis of genes and genomes*. Jones & Bartlett Learning.
4. Pierce, B. A. (2012). Genetics: a conceptual approach. Macmillan.
5. Klug, W. S., Cummings, M. R., Spencer, C. A., Palladino, M. A., & Ward, S. M. (2009). *Concepts of genetics* (pp. 463-464). Pearson.
6. Trun, N., & Trempy, J. (2009). *Fundamental bacterial genetics.* John Wiley & Sons.
7. Streips, U. N., & Yasbin, R. E. (Eds.). (2004). *Modern microbial genetics.* John Wiley & Sons.

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 – VI

Elective Course (EC)-EC-2

Course Title: Molecular Biology Techniques

Course Code: C6GEN5T1

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

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

CO1: understands the basics of molecular biology techniques

CO2: thinking of adopting the techniques to adopt in the academic research/dissertation

CO3: will be able to understand basic bioinformatics

Unit	Title: Molecular Biology Techniques	45 hrs/ sem
Unit I	Microscopy: Sample preparation light microscopy, phase contrast microscopy, Electron microscopy. Spectrophotometry, Fluorescence, Fluorescent microscopy, Confocal laser scanning microscopy, Flow cytometry, FACS. Radiochemistry-Scintallation Spectrophotometer, α -rays counter. PH and Buffer: pH measurement, centrifugation-Analytical preparative differential, Differential gradient. **Introduction to proteins:** Levels of protein structure, protein denaturation; chromatography-introduction types membrane and detergents, electrophoresis/SDS PAGE- IEF and protein detection. Protein purification and sequencing. Immunogens: Features, preparation, Antibodies- Immunoblotting, ELISA, Immunoprecipitation monoclonal antibodies.	15 hrs
Unit II	**Nucleic acids:** Structure and isolation of DNA and RNA; modifying DNA-Nucleases, restriction enzymes. Electrophoresis: Agarose and PFGE. Blotting and hybridization: Northern blots and Southern : blots. Probes: Radioactive and non-radioactive labelling; PCR: Quantitative PCR and types of PCR; Recombinant DNA: Vectors, ligation, identifying recombinants, expression of recombinant proteins, DNA sequencing.	15 hrs
Unit III	**Computational Biology or Bioinformatics:** Sequence alignments pair-wise sequence alignment. Database searching, BLAST search Genomes and proteomes: Initial identification and characterization protem identification, mixed peptide sequencing.	15 hrs

Recommended books:

1. Sambrook, J., Fritsch, E.F. and Meniates, T (2000): Molecular Cloning. CSHLPress. NY .

2. Glick. B.R., Pastemak J.J., 3rd Ed. (2003): Molecular Biotechnology: Principles and Application of Recombinant DNA. ASM Press, Washington DC Brooker R.J. 1999, *Genetic Analysis and Principles*, Benjamin/Cummings;Longman Inc.
3. Griffith A.J.F., J.H.Miller., D.T.Suzuki., R.C.Lewontin andW.M.Gelbert. 1996. *An Introduction to Genetic Analysis*. W.H.Freeman and Company. New York.
4. Snaustad D.P. and M.J.Simmonss 1997, *Principles of Genetics,* John Wiley and Sons Inc. NY.
5. Lewin. B.2000. *Gene VII.* O xford University Press, Oxford New York, Tokyo.
6. Watson J.D, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner, 1987. *Molecular Biology of Genes.* The Benjamin/Cummings Publishing Company. Inc.,Tokyo.
7. Lodish A. Berk, S.L.Zipursky, P.Mastsudaira, D.Baltimore and J Damell 1999. *Molecular Cell Biology*. W.H.Freeman and 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 –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: Applied Genetics Practical

Course Code: C0GEN6P1

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

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

CO1: The student will be able to master the technique in genetics

CO2: The technical insights will be understood behind experiments

CO3: student will be able to handle experiment independently

List of the Expedients, each will have 4rs / Week (Minimum 12 experiments)

1. Estimation Extraction of proteins from plant tissues
2. Estimation of proteins and regression curve construction
3. Estimation of proteins by CBB binding assay.
4. Isolation of DNA from plants
5. Analysis of quantity and quality of isolated DNA by spectrophotometer
6. Quantification of isolated DNA on agarose gel by densitometry
7. Calculation of molecular weight of DNA fragment
8. Extraction of RNA from plant and animal samples
9. Estimation of RNA by orcinol method
10. Preparation and study of metaphase chromosomes in wheat with different ploidy levels
11. Local Institute Visit.
12. Local Institute Industrial

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