



BANGALORE UNIVERSITY

Syllabus for

B.Sc. GENETICS (UG)

CHOICE BASED CREDIT SYSTEM (CBCS)

Framed According to the National Educational Policy (NEP 2020)

III & IV SEMESTERS

[To implement from the academic year 2022-23]

FOREWORD

Syllabus for B.Sc., Hons in Genetics

Name of the Degree Program: **B. Sc., Hons**
Discipline Core: **Genetics**
Total Credits for the Program: **50/100/142/184/268**
Starting year of implementation: **2021-22 (I & II sem)**
2022-23 (III & IV sem)

Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

Introduction The curriculum framework for B.Sc. degree in Genetics is structured to offer a broad outline that helps in understanding genetic factors and disorders about promoting health and preventing disease. The course is upgraded keeping in mind the aspirations of students, changing nature of the subject as well as the learning environment. The core concepts within subject have been updated to incorporate the recent advancements, techniques to upgrade the skills of learners. The syllabus under NEP-2020 is expected to enhance the level of understanding among students and maintain the high standards of graduate program offered in the country. Effort has been made to integrate the use of recent technology and MOOCs to assist teaching-learning process among students. The major objective of the graduate program is to elevate the subject knowledge among students, and making them as critical thinkers thereby students can address the issues related to genetics logically and efficiently and helps in securing a career in academia, industry, pharmaceutical research and development in private as well as public sectors. In a nutshell, the course serves as plethora of opportunities in different fields right from classical to clinical Genetics.

AIMS AND OBJECTIVES OF UG PROGRAM IN GENETICS

- The Program offers both classical as well as modern concepts of Genetics in higher education.
- It 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, pattern of inheritance.
- To correlate contemporary and modern techniques like genomics, metagenomics, genome editing and molecular diagnostic tools.
- Bioinformatics and computational tools used in modern sciences will provide ample opportunities to explore different career avenues and provide opportunity to be an entrepreneur.

GRADUATE ATTRIBUTES IN B.Sc. (Hons.) GENETICS

Some of the characteristic attributes a graduate in Genetics should possess are:

- Disciplinary knowledge and skills
- Skilled communication
- Critical thinker and problem solving capacity
- Logical thinking and reasoning
- Team spirit
- Leadership quality
- Digitally efficacy
- Ethical awareness/reasoning
- Lifelong learning

Flexibility

- The program is flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.

- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.

- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities

- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3. i and 3.ii).

- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.

- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

Weightage for assessments

Type of Course	Formative Assessment / IA Marks	Summative Assessment Marks
Theory	40	60
Practical	25	25
Projects*	45	105
Experiential Learning (Internships etc.)		

*In lieu of the research Project, two additional elective papers/ Internship may be offered

Credit distribution for the course

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka							
Example: Bachelor of Science (Basic/Hons.) (with Genetics & Botany as subjects with practicals) with one major and one minor							
Sem.	Discipline Core (DSC) (Credits)(L+T+P)	Discipline Elective (DSE)/ Open Elective (OE) (Credits)(L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits)(L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (Credits)(L+T+P)	Value based (Credits)(L+T+P)	
I	Genetics A1(4+2) Botany B1(4+2)	OE-1(3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: Digital Fluency(2)(1+0+2)	Physical Education for Health & Wellness fitness(1)(0+0+2) (1)(0+0+2)	25
II	Genetics A2(4+2) Botany B2(4+2)	OE-2(3)	L1-2(3), L2-2(3) (4 hrs. each)	Environmental Studies (2)		Physical Education - NCC/NSS/R	25
Exit option with Certificate (50 credits)							
III	Genetics A3(4+2) Botany B3(4+2)	OE-3(3)	L1-3(3), L2-3(3) (4 hrs. Each)		SEC-2: Artificial Intelligence(2)(1+0+2)	Physical Education - NCC/NSS/R	25
IV	Genetics A4(4+2) Botany B4(4+2)	OE-4(3)	L1-4(3), L2-4(3) (4 hrs. Each)	Constitution of India(2)		Physical Education - NCC/NSS/R	25
Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and the other as Minor							
V	Genetics A5(3+2) Genetics A6(3+2) Botany B5(3+2)	Vocational-1(3)			SEC-3: SEC such as Cyber Security (2) (1+0+2)		20
VI	Genetics A7(3+2) Genetics A8(3+2) Botany B6(3+2)	Vocational-2(3) Internship(2)			SEC-4: Professional Communication(2)		22
Exit option with Bachelor of Science Degree, B.Sc. Degree in Zoology (142 credits) or continue studies with the Major in the third year							
VII	Genetics A9(3+2) Genetics A10(3+2) Genetics A11(3)	Genetics E-1(3) Genetics E-2(3) Res. Methodology(3)					22
VIII	Genetics A12(3+2) Genetics A13(3) Genetics A14(3)	Zoology E-3 (3) Research Project(6)*					20
Award of Bachelor of Science Honours Degree, B.Sc.(Hons.) Degree in Genetics (184 credits) *In lieu of the research Project, two additional elective papers/Internship may be offered.							

*BOS resolved to adopt only B1 and B2 core subjects for the year 2021-22

SEMESTER WISE CURRICULUM STRUCTURE OF COURSES

Semester	Name of the course/credits	What all program outcomes the course addresses (not exceeding 3 /course)	Pre- requisite course(s)	Concurrent course	Pedagogy	Assessment
1 Semester A1Core	Cytology, Genetics and Infectious Diseases (4)	<ol style="list-style-type: none"> The structure and functions of animal cell, cell organelles, cell- cell interactions, process of reproduction leading to new organisms. The principles of inheritance, Mendel's laws and the deviations. Inheritance of chromosomal aberrations in humans by pedigree analysis in families. 	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Cell Biology and Genetics(2)	Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester B1 Core	Biology of Non-Chordates (4)	<ol style="list-style-type: none"> Learn the systematics and biology of non-chordates through their adaptive features. Study the functional biology of non-chordates through their body organization. Comprehend identification of species and their evolutionary relationships. 	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Non- Chordates (2)	Lectures/Videos/ Seminars/Case study/Project/ Formative Assessment/ Summative	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
1 Semester OE1Open Elective course	Economic Zoology (3)	<ol style="list-style-type: none"> Acquaint the knowledge about basic procedure and methodology of integrated animal rearing. Students can start their own business i.e. self- employments. Get employment in different sectors of Applied Zoology 	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of pedagogy,
SEC 1 Skill Enhancement course	SEC 1 Digital fluency Vermiculture(2)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminars/Case study/Project/ Group discussion/Problem Solving/Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester A2	Biochemistry and Physiology (4)	<ol style="list-style-type: none"> In depth understanding of structure of biomolecules like proteins, lipids and carbohydrates. The thermodynamics of enzyme catalyzed reactions. To know various physiological processes of animals. 	Student must have studied Biology or equivalent subjects in Class 12.	A2 Lab on Biochemistry, Physiology and Hematology (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,

2 Semester B2	Biology of Chordates (4)	<ol style="list-style-type: none"> 1. Learn the systematics and biology of Chordates through their adaptive features. 2. Study the functional biology of Chordates through their body organization. 3. Comprehend identification of Chordate species and their evolutionary relationships. 	Student must have studied Biology or equivalent subjects in Class 12.	Lab on Biology of Chordates (2)	Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Semester OE2 Open Elective course	Parasitology(3)		Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/Evaluation/ Analysis of result/ Application of Heutagogy,
2 Skill Enhancement course	Environmental Studies Sericulture(2)	<ol style="list-style-type: none"> 1. Sericulture is an agro-based industry which gives economic empowerment to the students. 2. Sericulture may be taken up as a small scale industry by the small farmers and unemployed youth. 3. Get jobs in teaching 	Student must have studied Biology or equivalent subjects in Class 12.		Lectures/Videos/ Seminar/Case study/Project/ Formative Assessment/ Summative Assessment	Formative and Summative Assessment/ Evaluation/ Analysis of result/ Application of Heutagogy,
EXIT OPTION WITH CERTIFICATE (50 CREDITS)						

2. Course Structure

5.1 Credit distribution for the course

Semester	Course Opted	Course Name	Credits
I	MajorCoreCourse-1(Theory)	Cell Biology and Genetics	4
	MajorCoreCourse-1(Practical)	CellBiologyandGenetics	2
	MinorDisciplineCourse-1(Theory)	Nutritional Genetics	4
	MinorDisciplineCourse-1(practical)	Nutritional Genetics	2
	OpenElectiveCourse-1(Theory)	Principles of Genetics	3
	Skill Enhancement (Vocational) Elective Course -1(Practical)	Genetic Counselling	2
II	MajorCoreCourse-2(Theory)	Bio-Instrumentation and Animal Cell Culture	4
	MajorCoreCourse-2(Practical)	Bio-Instrumentation and Animal Cell Culture	2
	MinorDisciplineCourse-2(Theory)	Medical Genetics	4
	MinorDisciplineCourse-2(Practical)	Medical Genetics	2
	OpenElectiveCourse-2(Theory)	Genetic Counselling	3
Exit option with certificate in Genetics(50credits)*			
III	MajorCoreCourse-3(Theory)	Bio molecules and Molecular Genetics	4
	MajorCoreCourse-3(Practical)	Biomolecules and Molecular Genetics	2
	MinorDisciplineCourse-3(Theory)	Pharmaco-genetics	4
	MinorDisciplineCourse-3(Practical)	Pharmaco-genetics	2
	OpenElectiveCourse-3(Theory)	Eugenics, Euthenics and Society	3
	Skill Enhancement (Vocational)Elective Course - 3(Practical)	Genetic diagnostics and Public Health	2
IV	MajorCoreCourse-4(Theory)	Human Genetics sand Genetic Counselling	4
	MajorCoreCourse-4(Practical)	Human Genetics and Genetic Counselling	2
	Minor Discipline Course–4(Theory)	Medical and Environmental impact on development	4
	Minor Discipline Course–4(Practical)	Medical and Environmental impact on development	2
	OpenElectiveCourse-4(Theory)	Human Genetic Disorders	3
Exit option with Diploma in Genetics(100credits)*			
V	MajorCoreCourse-5(Theory)	Gene Regulation and DNA Repair	3
	MajorCoreCourse-5(Practical)	Gene Regulation and DNA Repair	2
	MajorCoreCourse-6(Theory)	Plant cell and Tissue culture Technology	3
	MajorCoreCourse-6(Practical)	Plant cell and Tissue culture Technology	2
	MinorDisciplineCourse-5 Theory)	Radiation Genetics	3
	MinorDisciplineCourse-5(Practical)	Radiation Genetics	2
	Discipline Specific Elective Course–5(Theory)	Clinical Genetics	3
	VocationalElectiveCourse-1(Practical)	Geno-toxicology	2

VI	MajorCoreCourse-7(Theory)	Genes and Development	3
	MajorCoreCourse-7(Practical)	Genes and Development	2
	MajorCoreCourse-8(Theory)	Population and Evolutionary Genetics	3
	Major Core Course –8(Practical)	Population and Evolutionary Genetics	2
	MinorDisciplineCourse-6(Theory)	Scientific Communication	3
	MinorDisciplineCourse-6(Practical)	Scientific Communication	2
	Discipline Specific Elective Course–6(Theory)	Statistical Genetics	3
	VocationalElectiveCourse-2(Practical)	Seed Science and Technology	3
	Internship	Research Centers/Industries/Hospitals	2
Exit option with B.Sc.in Genetics (142credits)*			
VII	MajorCoreCourse-9(Theory)	Immunology and Immunogenetics	3
	MajorCoreCourse-9(Practical)	Immunology and Immunogenetics	2
	MajorCoreCourse-10(Theory)	Cancer and Radiation Genetics	3
	MajorCoreCourse-10(Practical)	Cancer and Radiation Genetics	2
	MajorCoreCourse-11(Theory)	Microbial Genetics and Technology	3
	MajorCoreCourse-11(Practical)	Microbial Genetics and Technology	2
	Discipline Specific Elective Course–7(Theory)	Animal Biotechnology	3
	Discipline Specific Elective Course–7(Theory)	Forensic Genetics	3
	Open Elective	Research Methodology	3
VIII	MajorCoreCourse-12(Theory)	Neurogenetics and Neurological disorders	3
	MajorCoreCourse-12(Practical)	Neurogenetics and Neurological	2
	MajorCoreCourse-13(Theory)	Behavioural Genetics	3
	MajorCoreCourse-13(Practical)	Behavioral Genetics	2
	MajorCoreCourse-14(Theory)	Plant Breeding	3
	MajorCoreCourse-14(Practical)	Plant Breeding	2
	Discipline Specific Elective Course–8(Theory)	Plant Biotechnology	3
	Research Project	Based on student interest and teacher expertise	6
Exit option with B.Sc.(Hons)in Genetics(184credits)*			
IX	MajorCoreCourse-15(Theory)	Genetic Engineering and Stem Cell technology	4
	MajorCoreCourse-15(Practical)	Genetic Engineering and Stem Cell technology	2
	MajorCoreCourse-16(Theory)	Computational Genetics	4
	MajorCoreCourse-16(Practical)	Computational Genetics	2
	Discipline Specific Elective Course–9(Theory)	Genomics and Proteomics	3
	Skill Enhancement(Vocational)Elective Course -9	Assisted Reproductive techniques	2
X	MajorCoreCourse-17(Theory)	Advanced cellular and Molecular Genetics	4
	MajorCoreCourse-17(Practical)	Advanced cellular and Molecular Genetics	2

3. CURRICULUMSTRUCTURE

CURRICULUMSTRUCTUREFORUNDERGRADUATEDEGREEPROGRAMINGENETICS

Name of the Degree: B.Sc.(Hons) Specialization: Genetics (I & II sem) Program Articulation Matrix:

This matrix lists only the core courses. Core courses list the courses that are essential for every student to earn his degree. It includes all types of courses (theory, lab, tutorial, Project, Internships, that every student of the course).

Sem.	Name of the course (with code)	What all program outcomes the course addresses (not exceeding three per course)	Prerequisite courses	Concurrent course (with code)#	Pedagogy##	Assessment\$
I	Cell Biology And Genetics(DSCC5 GENT1)	<ol style="list-style-type: none"> Understand the structure and function of all the cell organelles. Know about the chromatin structure and its location. Understand the Mendel's laws and its deviations. 	Life science studied as of the options in 12 th standard	Cell Biology and Genetics(DSCC5 GENP1)	House Examination/Test/Seminars/ Assignment/Minor project/ Active learning/ Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy,
I	Nutritional Genetics(MDC5 GENT1)	<ol style="list-style-type: none"> Understand relationship between food, microbiome, genome and epigenome. Know how a plateful of meal can control metabolism, prevent diseases and improve health. Learn importance of nutritional defects of adulterants. 	Life science studied as of the options in 12 th standard	Nutritional Genetics(MDC5 GENP1)	House Examination/Test/Seminars/ Assignment/Minor project/ Active learning/ Problem based/Review Writing/ Paper presentation/ Case studies	Formative/summative assessment, Evaluation/Result analysis/Application of Heutagogy,

I	Principles of Genetics (OEC5GENT1)	<ol style="list-style-type: none"> 1. Study historical overview and laws of Inheritance. 2. Understand Mendel's principles and deviations. 3. Gene interactions and their outcome through gene mapping. 	Life science studied as of the options in 12 th standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/ Review Writing/ Paper presentation/Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy,
I	Genetic Counseling(VE C5GENP1)	<ol style="list-style-type: none"> 1. Learning methods of genetic testing 2. understanding pedigree construction, analysis and risk calculation 3. intensive practical knowledge of Genetic Counseling. 	Life science studied as of the options in 12 th standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/Case studies	Formative /summative assessment, Evaluation/Result analysis/Application of Heutagogy
II	Bio-instrumentation &Animal cell Culture(DSCC5G ENT2)	<ol style="list-style-type: none"> 1. Understand the basic principles of different laboratory equipments. 2. Know the uses of the analytical equipments in various biological applications. <p>Understand the cell lines and culture media and cell culture methods</p>	Life science Studied as of the options in 12 th standard	Bio-instrumentation &Animal Cell Culture(DSCC5G ENP2)	House Examination/Test/ Seminars/Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/Result analysis/ Application of Heutagogy
II	Medical Genetics(MDC5 GENT2)	<ol style="list-style-type: none"> 1. Understand genetic basis of human diseases and disease gene identification 2. Have insight of techniques used in medical genetics 3. Have thorough knowledge of gene therapy and its strategies 	Life science studied as of the options in 12 th standard	Medical Genetics(MDC5 GENP2)	House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/ Result analysis/ Application of Heutagogy
II	Genetic Counselling(OE C5GENT2)	<ol style="list-style-type: none"> 1. Genetic counselling methods 2. Reproductive risk calculation 3. Ethical and legal issues of genetic counselling 	Life science studied as of the options in 12 th standard		House Examination/Test/Seminars/ Assignment/ Minor project/ Active learning /Problem based/Review Writing/ Paper presentation/ Case studies	Formative /summative assessment, Evaluation/ Result analysis/ Application of Heutagogy

III SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS
DISCIPLINE SPECIFIC CORE COURSE DSCC
THEORY PAPER: BIOMOLECULES AND MOLECULAR GENETICS

1. Course Description

Semester: III	Course Title: Biomolecules and Molecular Genetics
Course Code:	Course Type: DSCC5GENT3
Course Credits	4
Total hours :	56
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Duration of DSC	4Hours

2. Course Objectives:

- Understand concepts of biomolecules and gene organization
- Comprehend the central dogma of molecular biology.
- Understand gene structure and expression.
- Appraise DNA repair mechanism.

3. Course Outcome:

Course Outcome (Cos): After completing this course, the student will be able to:

- Describe the structure and function of biomolecules.
- Appreciate and illustrate the chemical composition of the genetic material and its replication.
- Describe the process of gene expression in prokaryotes and eukaryotes.
- Explain the concept of transposition, mutation and DNA repair mechanism.

4. COURSE CONTENT

Content	Hours 56
Unit 1: Biomolecules: <ul style="list-style-type: none"> a. Carbohydrates: Structure, classification and functions of carbohydrates b. Lipids: Saturated and unsaturated fatty acids, Tri-acyl glycerol, phospholipids, glycolipids and steroids. c. Proteins: Structure, classification, and general properties of α-amino acids, organizations of protein-simple and conjugate protein. Peptide Linkages- d. Enzymes: Properties, classification and functions. 	14

<p>Unit 2: Chemical basis of Heredity</p> <p>a. Introduction: DNA (Hershey and Chase experiment) and RNA (Fraenkel and Singer experiment) as genetic material.</p> <p>b. Structure and functions of DNA: structure of DNA, Chargaff's rule, forms of DNA - A, B and Z; Functions of DNA and RNA including ribozymes;</p> <p>c. DNA replication in Prokaryotes and Eukaryotes. Initiation, continuous and discontinuous synthesis and termination. Enzymes and proteins involved in replication, Theta model and rolling circle model.</p>	14
<p>Unit 3: Protein synthesis and gene regulation</p> <p>a. Protein biosynthesis: Types of RNA, structure of tRNA, aminoacyl-tRNA synthetase; Transcription: initiation elongation, termination in prokaryotes and eukaryotes, Post-transcriptional modifications: Methylation, polyadenylation and RNA splicing. Gene-silencing by RNA interference; Genetic code; Translation and post translational modification of Proteins.</p> <p>b. Regulation of gene expression in bacteria- Lac Operon and Trp Operon; Overview of regulation of gene expression in eukaryotes, regulation of galactose metabolism in yeast.</p>	14
<p>Unit 4: Transposons, Mutations and DNA repair mechanism</p> <p>a. Transposons - IS elements in bacteria, p elements in <i>Drosophila</i>, AC-DS in Maize;</p> <p>b. Mutations- Types of point mutations -Transition and transversion, base substitution Mutation- missense, non-sense, neutral and silent mutation. Frame shift Mutation-Insertion and deletion Mutations., Mutagens-physical and chemical, Detection of mutation - Ames test; Beneficial and harmful effects of mutation.</p> <p>c. DNA repair mechanism—photo reactivation, Mismatch repair, excision and SOS repair.</p>	14

5. Resources

a) Reference Books:

- Becker, W.M. & Klein smith, L. J. (2017), World of the cell (9th Ed.), Benjamin Cummings, Washington DC.
- Cooper, G.M. (2013), The Cell (6th Ed.).SinauerAssociates,Sunderland.
- Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2007) AnIntroduction to Genetic Analysis (9th Ed.), Freeman, New York.
- Hames, B. D. & Hooper, N. M. (2011). Instant Notes in Biochemistry (4th Ed.). Viva Books.
- Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. &Veres, R. C. (2016)
- Genetics: From Genes to Genomes,Tata–McGraw Hill, New Delhi.
- Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2018). Molecular Cell Biology (6th Ed.). Freeman. New York.
- Lodish, J. H & Baltimore, D. (2016). Molecular Cell Biology (8th Ed.), Scientific American Books, New York.

**III SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS
DISCIPLINE SPECIFIC CORE COURSE DSCC
PRACTICAL PAPER: BIOMOLECULES AND MOLECULAR GENETICS**

1. Course Description

Semester: III	Course Title: Biomolecules and Molecular Genetics
Course Code:	Course Type: DSCC5GENP3
Course Credits:	2
Total contact hours : 56 hrs.	Duration of MD: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

2. Course Objectives:

- Qualitative analysis of biomolecules
- Understand the principle and working of different laboratory instruments.
- Extract genomic DNA and run the DNA in a gel through gel electrophoresis.
- Perform paper chromatography and thin layer chromatography
- Study effects of mutations and molecular markers.

3. Course Outcomes:

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

- Understand the working principle and handling of instruments.
- Perform the isolation of DNA from various sources.
- Characterize the eye pigments in *Drosophila* using paper chromatography.
- Demonstrate the effects of mutation and appraise the applications of molecular markers.

4. Course Content:

Sl No	Experiment	Hrs
1	Qualitative analysis of Carbohydrates(Mohlish's test, Iodine Test , Benedict's test)	03
2	Qualitative analysis of Protein(Biuret and Ninhydrin test)	03
3	Qualitative analysis of Lipid(test for free fatty acid, saponification test)	03
4	Instrumentation–Micropipette, Glass Homogenizer, Glass bead sterilizer and PCR machine	03
5	Extraction of genomic DNA from coconut endosperm	02
6	Extraction of genomic DNA from liver tissue	03
7	Extraction of genomic DNA from bacteria	03
8	Separation of eye pigments in wild type and mutant <i>Drosophila</i> Using Chromatography.	03
9	Separation of chlorophyll from leaf pigment – Paper chromatography	03
10	Demonstration of DNA and Protein Profiling.	02
11	Study of mutations: Sickle cell anemia–Missense mutation; Thalassemia–frame shift mutation	02

III SEMESTER B. Sc. GENETICS (HONS) THEORY SYLLABUS
OPEN ELECTIVE COURSE- OEC
THEORY PAPER: Eugenics, Euphenics and Society

1. Course Description

Semester: III	Course Title: Eugenics, Euphenics and Society
Course Code:	OEC5GENT3
Course Credits:	3
Total hours :	42
Formative Assessment Marks: 40	Summative Assessment Marks: 60

2. Course Objectives

- Study the eugenics and Assisted reproductive technology
- Understand the prenatal diagnosis
- Understand genetic counselling and gene therapy

3. Course Outcomes

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

- explain the basic concepts of eugenics and Assisted reproductive technology
- appraise the concept of preimplantation and prenatal diagnosis
- interpret the importance of genetic counselling
- appraise the concept of gene therapy and its significance

4. Course Content

Content	Hours 42
<p>Unit 1: Introduction to Eugenics Eugenics - Concept, types-positive and negative Eugenics, Eugenics in United States, Nazism and decline of Eugenics; Modern Eugenics- genetic engineering and modern reproductive technologies, <i>in vitro</i> fertilization, female and male infertility, steps in IVF techniques, Sperm and Oocyte preservation; Euphenics Euthenics - environment pollution and parasitism; Ethical issues.</p>	14
<p>Unit 2: Prenatal diagnosis Indications for prenatal diagnosis; Methods- Non-invasive method- Ultrasonography and Foetal echocardiography, Invasive methods – Amniocentesis and Chorionic villus sampling. Introduction to pre-implantation genetic diagnosis. Genetic testing and screening.</p>	14
<p>Unit 3: Gene therapy Introduction, somatic and germ line gene therapy <i>Ex vivo</i> and <i>In vivo</i> gene therapy; viral vectors, delivery methods; Gene Therapy and diseases- Cystic fibrosis, haemophilia; Cancer gene therapy, Gene therapy of non-heritable disorders; Cord blood banking and stem cell banking, Stem cell therapy</p>	14

5. Resources

a) Reference Books:

1. Gardner and Sutherland's chromosome abnormalities and genetic counselling, R.J. McKinlay Gardner and David J. Amor (2018).
2. Genetic counseling: ethical challenges and consequences, Dianne M. Bartels, Bonnie S. LeRoy, and Arthur L. Caplan (2011).
3. Ajay Paul (2000) Genetics- from genes to genomes, 6th edition, Books and Allied (P), Ltd
4. Foundations of perinatal genetic counseling: a guide for counselors, Amber Mathiesen and Kali Roy (2018).
5. Rimmon et al (2002) Principles and Practice of Medical Genetics, Vol I-III.
6. Martin H. Johnson & Barry Everitt. Essential reproduction.
7. Peter Snustad and Michael J Simmons (2009). Principles of Human Genetics. Fifth Edition. John Wiley & Sons, Inc.
8. Strachan T and Read A 2010 Human Molecular Genetics, Fourth Edition. Taylor and Francis
9. Ricki Lewis (2009) Human Genetics-Concepts and Application. Ninth Edition. McGraw-Hill College Publishers

IV SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS
DISCIPLINE SPECIFIC CORE COURSE DSCC
THEORY PAPER: DSCC5GENT4: HUMAN GENETICS AND GENETIC
COUNSELLING

1. Course Description:

Semester: IV	Course Title: Human Genetics and Genetic Counselling
Course Code:	Course Type: DSCC5GENT4
Course Credits	4
Total hours :	56
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Duration of DSC	4Hours

2. Course Objectives:

- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Understand the components of immune system and the role of genes in immune development.
- Comprehend prenatal diagnosis method and use of cell therapy and gene therapy for genetic disease.
- Understand the objective of Genetic counseling and its steps involved.

3. Course Outcomes:

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

- Understand the nomenclature of Human chromosome and chromosomal inheritance pattern.
- Understand cells of immune system, structure of immunoglobulin and role of MHC in transplantation.
- Understand Prenatal diagnosis method and gene therapy for treating Genetic disease.
- Appreciate Genetic counselling and steps involved in it.

4. Course Content

Content	56 Hrs
<p>UNIT I: Human chromosomes and chromosomal Inheritance Pattern</p> <p>a. Human Chromosomes: Normal Human Karyotype: Paris Nomenclature, Flow karyotyping, FACS - Fluorescence Activated Cell Sorter.</p> <p>b. Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (Eg. Adult polycystic kidney and Neurofibromatosis) Autosomal inheritance- Recessive (Eg. Albinism, Sickle cell anemia) X-linked – Recessive: (Eg. Duchene muscular dystrophy) X-linked Dominant- (Eg. Hypophosphatemia) Y-linked inheritance- Holandric gene (E.g. Testes determining factor - TDF) Multifactorial inheritance: (Eg. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Eg. Leber’s hereditary optic neuropathy).</p>	14

<p>Unit 2: Immunogenetics</p> <p>a. Introduction to immunology- types and properties of antigens, antibodies, B and T Cells, Immunity types - Innate and acquired. Immune response - Humoral and Cell mediated,</p> <p>b. Genetics of immune system – antibody gene rearrangement and class switching. Inherited immunodeficiency- Ex. X- linked agammaglobulinaemia.</p> <p>c. Major Histocompatibility Complex- Types, HLA disease associations. Transplantation, graft-rejection and immunosuppressors Concept of immunization</p>	14
<p>Unit 3: Prenatal diagnosis and gene therapy</p> <p>a. Indications for prenatal diagnosis; Methods- Noninvasive method- Ultrasonography and Fetal echocardiography, Invasive methods - Amniocentesis, Chorionic villus sampling; Pre-conception and pre-implantation genetic diagnosis- Teratogen exposure in early pregnancy, Genetic testing and screening.</p> <p>b. Gene therapy with reference to SCID Stem cells- Properties, types and sources. Cord blood banking and Stem cell therapy</p>	14
<p>Unit 4: Genetic Counselling:</p> <p>a. Symbols used in pedigree studies, Pedigree construction and analysis, Pedigree analysis for the inheritance pattern of genetic diseases,</p> <p>b. Genetic Counseling. –Introduction to Genetic counseling; Historical over view, Stage of counseling, scope of Genetic counselling.</p> <p>c. Roles and responsibilities of Counselor and Consultant - needs, rights; Ethical, legal and social issues (ELSI), Acts and Amendments.</p>	14

5. References:

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R.Korf. 2000
8. Human Genetics: Concepts and Applications by Lewis R (2001) McGrawHi; Boston.
9. Human Genetics by S.D. Gangane (2nd Edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
10. Medical Genetics. Lynn Jorde John CareyMichael Bamshad. 2015.
11. Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
12. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds) Mc Graw Hill, New York.

IV SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS
DISCIPLINE SPECIFIC CORE COURSE DSCC
PRACTICAL PAPER: DSCC5GENP4: HUMAN GENETICS AND GENETIC COUNSELLING

1. Course Description

Semester: IV	Course Title: Human Genetics and Genetic Counselling
Course Code:	Course Type: DSCC5GENP4
Course Credits:	2
Total contact hours : 56 -	Duration of MD: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks:25

2. Course Objectives:

- Study of inactivated X chromosome from buccal and blood smear
- Count RBC and WBC using Heamocytometer, identify different types of WBC using Differential staining technique.
- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Construct and analyse Pedigree.
- Study different types of kit based immunological techniques.

3. Course Outcomes:

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

- Identify inactivated X chromosome.
- Perform and able to identify different WBC using Differential staining.
- Understand the nomenclature of chromosome and perform Karyotype of normal and Abnormal Human chromosomes.
- Construct and analyze Pedigree.
- Appreciate and understand different immunological techniques.

4. Course Content:

Sl No	Experiment	Hrs
1	Study of Barr body in the Buccal epithelial cells	4
2	Study of drum sticks in Neutrophils of Blood smear	4
3	Blood Cell counting using Haemocytometer (RBC and WBC)	8
4	Differential staining of blood cells	4
5	Demonstration of short-term blood lymphocyte culture — Washing and sterilization of glassware and plastic ware, Preparation of solutions and culture medium, Harvesting the culture,	8
6	Demonstration of Preparation of metaphase spread, Staining, Banding and Scoring.	4
7	Study of Karyotypes I: Normal Karyotypes in Human Study of Karyotypes II: Abnormal Karyotypes. • Down's syndrome (autosomal). • Turner's syndrome (sex chromosomal) • Klinefelter's syndrome (sex chromosomal)	4
8	Preparation of Normal and abnormal Karyotypes	6
9	Pedigree construction and analysis.	6
10	Performance of Ouchterlony Double Diffusion (ODD) • Radial Immuno diffusion (RID) •Dot ELISA.	8

IV SEMESTER B. Sc. GENETICS (HONS) THEORY SYLLABUS
OPEN ELECTIVE COURSE OEC
THEORY PAPER: Human Genetic Disorders

1. Course Description

Semester: III	Course Title: Human Genetic Disorders
Course Code:	OEC5GENT4
Course Credits:	3
Total hours :	42
Formative Assessment Marks: 40	Summative Assessment Marks:60

2. Course Objectives:

- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Understand the concept of one gene one enzyme hypothesis with examples.
- Study different single gene and multifactorial diseases.

3. Course Outcomes:

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

- Understand the nomenclature of Human chromosome and chromosomal inheritance pattern.
- Appreciate and understand one gene one enzyme hypothesis.
- Understand the pattern of inheritance of various genetic diseases.

4. Course Content

Content	Hours 42
<p>Unit 1: Human Chromosomes, study of Normal Human Karyotype and abnormal karyotypes. Pattern of inheritance: Autosomal dominant –Adult polycystic kidney disease. Autosomal recessive – Sickle cell anaemia, X-linked dominant – Fragile X syndrome, X linked recessive – Duchenne muscular dystrophy, Y linked inheritance and mitochondrial inheritance pattern.</p>	14
<p>Unit 2: Inborn errors of metabolism–Introduction, concept of one gene one enzyme hypothesis. Disorders of carbohydrate metabolism–Galactosaemia; Disorders of amino acid metabolism – Alkaptonuria Disorders of Lysosomal enzymes–Tay- Sachs disease Disorders of Lipoprotein and lipid metabolism – Hyper Lipoproteinemia;</p>	14
<p>Unit 3: Single gene disorder, complex disorder and gene therapy Introduction to single gene disorder and complex diseases, Genetics of haemophilia and Albinism. Multifactorial/ Complex disease - Diabetes. Gene Therapy, Types of gene therapy, Cancer gene therapy, Cord blood banking, stem cell banking and Stem cell therapy</p>	14

References:

1. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) a Rastogi Publications, Meerut.
2. Emery's Elements of Medical Genetics- Peter Turnpenny, SlanEllard 15th Edition. 2017.
3. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
4. Genetic basis of common diseases by R. A. King et al, Oxford University Press 2002.
5. Genetics in Medicine by M.W. Thompson et al, 5 Edition, W.B. Saunders Company, London 1996.
6. Human Cytogenetics. Denise Rooney Oxford University Press, 2001.
7. Human Genetics – Bruce.R.Korf. 2000

Course pattern and scheme of examination for B.Sc./ B.Sc. (Hons.) as per NEP (2021-22 onwards)

Subject: GENETICS

SL No.	Semester	Title of the paper	Teaching hours	Hours / week		Examination Pattern Max. & Min. Marks /Paper						Duration of Exam (hours)		Total Marks / paper	Credits	
				Theory	Practical	Theory			Practical			Theory	Practical		Theory	Practical
						Max.	MIN.	IA	Max.	MIN.	IA					
1	I	CORE subject	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		Open elective	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	3	50	-	2
2	II	CORE subject	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		Open elective	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	3	50	-	2

Scheme of Internal Assessment Marks: Theory

Sl. No.	Particulars	IA Marks
1	Attendance	05
2	Internal Tests (Minimum of Two)	20
3	Assignments /Seminar / Case Study / Project work / Reports on - Field visits made for observation and collection of data etc.,	15
TOTAL Theory IA Marks		40

Practicals:

Sl. No.	Particulars	IA Marks
1	Practical Test	10
2	Report / Seminar on practical experiments, etc.	10
3	Active participation in practical classes (Attendance)	05
TOTAL Theory IA Marks		25

Scheme of Practical Examination
BSc. Genetics III Semester
Core Subject: DSCC5GENP3; BIOMOLECULES AND MOLECULAR GENETICS

Duration: 3 hours

Max. marks: 25

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|--|------|
| 1. Isolation of DNA from coconut endosperm/ Bacteria/liver | 10 M |
| 2. Separate the chlorophyll from leaf pigment / <i>Drosophila</i> eye pigments by using ascending paper Chromatography | 07M |
| 3. Perform and comment on the qualitative test for carbohydrate/protein/lipid (any two) | 06M |
| 4. Identify and comment on Spotter A (Sickle cell anemia/ thalassemia). | 03M |

TOTAL Marks 25M

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Scheme of Practical Examination
BSc. Genetics IV Semester
Genetics Core Subject: DSCC5GENP4: HUMAN GENETICS AND GENETIC COUNSELLING

Duration: 3 hours

Max. marks: 25

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|--|-----|
| 1. Prepare a Buccal smear / Blood smear for sex chromatin and comment | 06M |
| 2. Count the RBC / WBC in the blood sample. Calculate and report the results | 06M |
| Or | |
| Prepare Differential staining of Blood smear and comment on the result | |
| 3. Construct pedigree for the given data / analyze the given Pedigree | 05M |
| 4. 4) Identify and comment on the given Karyotype | 04M |
| 5. Identify and comment on the given spotters A and B
(ODD/RID/Dot ELISA) | 04M |

TOTAL Marks 25M