

## **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
<b>Exit option with Certificate (50 credits)</b>							
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
<b>Exit option with Diploma in Science (100 credits) OR Choose any one of the core subjects as Major and the other as Minor</b>							
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
<b>Exit option with Bachelor of Science Degree, B. Sc. Degree in Zoology (142 credits) or continue studies with the Major in the third year</b>							
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
<b>Award of Bachelor of Science Honours Degree, B.Sc.(Hons.) Degree in Genetics (184 credits)</b>							
<b>*In lieu of the research Project, two additional elective papers/ Internship may be offered.</b>							

## 2. Course Structure

### 5.1 Credit distribution for the course

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

VI	Major Core Course- 7 (Theory)	Genes and Development	3
	Major Core Course - 7 (Practical)	Genes and Development	2
	Major Core Course- 8 (Theory)	Population and Evolutionary Genetics	3
	Major Core Course – 8 (Practical)	Population and Evolutionary Genetics	2
	Minor Discipline Course -6 (Theory)	Scientific Communication	3
	Minor Discipline Course -6 (Practical)	Scientific Communication	2
	Discipline Specific Elective Course – 6 (Theory)	Statistical Genetics	3
	Vocational Elective Course -2 (Practical)	Seed Science and Technology	3
	Internship	Research Centers/Industries/Hospitals	2
Exit option with B.Sc. in Genetics (142credits)*			
VII	Major Core Course- 9 (Theory)	Immunology and Immunogenetics	3
	Major Core Course- 9 (Practical)	Immunology and Immunogenetics	2
	Major Core Course- 10 (Theory)	Cancer and Radiation Genetics	3
	Major Core Course- 10 (Practical)	Cancer and Radiation Genetics	2
	Major Core Course- 11 (Theory)	Microbial Genetics and Technology	3
	Major Core Course- 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	Major Core Course- 12 (Theory)	Neurogenetics and Neurological disorders	3
	Major Core Course- 12 (Practical)	Neurogenetics and Neurological	2
	Major Core Course- 13 (Theory)	Behavioural Genetics	3
	Major Core Course- 13 (Practical)	Behavioral Genetics	2
	Major Core Course- 14 (Theory)	Plant Breeding	3
	Major Core Course- 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 (184 credits)*			
IX	Major Core Course- 15 (Theory)	Genetic Engineering and Stem Cell technology	4
	Major Core Course- 15 (Practical)	Genetic Engineering and Stem Cell technology	2
	Major Core Course- 16 (Theory)	Computational Genetics	4
	Major Core Course- 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	Major Core Course- 17 (Theory)	Advanced cellular and Molecular Genetics	4
	Major Core Course- 17 (Practical)	Advanced cellular and Molecular Genetics	2

Major Core Course- 18 (Theory)	Animal/ Experimental Genetic System and Pharmacodynamics	4
Major Core Course- 18 (Practical)	Animal/ Experimental Genetic System and Pharmacodynamics	2
Major Core Course- 19 (Theory)	Environmental Genetics	2
Major Core Course- 19 (Practical)	Environmental Genetics	
Discipline Specific Elective Course – 10 (Theory)	Genetic Engineering	3
Skill Enhancement (Vocational) Elective Course -9	Assisted Reproductive techniques	2
<b>Exit option with M.Sc. in Genetics (268 credits)*</b>		

### 3. CURRICULUM STRUCTURE

#### CURRICULUM STRUCTURE FOR UNDER GRADUATE DEGREE PROGRAM IN GENETICS

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 (DSCC5GE NT1)	<ol style="list-style-type: none"> <li>Understand the structure and function of all the cell organelles.</li> <li>Know about the chromatin structure and its location.</li> <li>Understand the Mendel's laws and the its deviations.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Cell Biology and Genetics (DSCC5GE NP1)	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 (MDC5GE NT1)	<ol style="list-style-type: none"> <li>Understand relationship between food, microbiome, genome and epigenome.</li> <li>Know how a plateful of meal can control metabolism, prevent diseases and improve health.</li> <li>Learn importance of nutrition and effects of adulterants.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Nutritional Genetics (MDC5GENP1)	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"> <li>1. Study historical overview and laws Inheritance.</li> <li>2. Understand Mendel's principles and deviations.</li> <li>3. Gene interactions and their outcome through gene mapping.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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 (VEC5GENP1)	<ol style="list-style-type: none"> <li>1. Learning methods of genetic testing</li> <li>2. understanding pedigree construction, analysis and risk calculation</li> <li>3. intensive practical knowledge of Genetic Counseling.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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 (DSCC5GENT2)	<ol style="list-style-type: none"> <li>1. Understand the basic principles of different laboratory equipments.</li> <li>2. Know the uses of the analytical equipments in various biological applications.</li> </ol> <p>Understand the cell lines and culture media and cell culture methods</p>	Life science Studied as of the options in 12 <sup>th</sup> standard	Bio-instrumentation & Animal Cell Culture (DSCC5GENP2)	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 (MDC5GEN T2)	<ol style="list-style-type: none"> <li>1. Understand genetic basis of human diseases and disease gene identification</li> <li>2. Have insight of techniques used in medical genetics</li> <li>3. Have thorough knowledge of gene therapy and its strategies</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> standard	Medical Genetics (MDC5GENP2)	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 (OEC5GEN T2)	<ol style="list-style-type: none"> <li>1. Genetic counselling methods</li> <li>2. Reproductive risk calculation</li> <li>3. Ethical and legal issues of genetic counselling</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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 SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS**  
**DISCIPLINE SPECIFIC CORE COURSE DSCC**  
**THEORY PAPER: DSCC5GENT1: CELL BIOLOGY AND GENETICS**

Course Title: Cell Biology and Genetics Code DSCC5GENT1	Course Credits:04
Total Contact Hours: 56	Duration of DSC: 4Hours
Formative Assessment Marks: 40	Summative Assessment Marks:60

Course Outcomes:

By the end of the course the students will be able to

1. Understand the structure and function of all the cell organelles.
2. Know about the chromatin structure and its location.
3. Understand the Mendel's laws and its deviations.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
I. Core competency	x											
II. Critical thinking	x											
III. Analytical reasoning	x											
IV. Research skills	x											
V. Team work	x											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

**Course Content**

Chapter	Content	Hours
	Unit - 1	14
01	Ultrastructure, chemical composition and functions of Plasma membrane. Ultrastructure and functions of Cytoplasmic organelles: Mitochondria, Krebs' cycle, BIS oxidative phosphorylation, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies and Cytoskeleton.	
02	Nucleus: Morphology, nuclear envelope, nucleoplasm, nucleolus and chromatin.	

03	Ultra structure of Eukaryotic Chromosome: Macro-molecular organization- Nucleosome model. Primary and Secondary constriction, SAT-bodies, Special chromosomes- structure and function of Polytene and Lampbrush chromosome	
Chapter	Unit – 2	14
04	Molecular Basis Cell Cycle and Cell Division: G1, S, G2 and M phase, Checkpoints. Mitosis: Stages, Mitotic apparatus, cytokinesis, Mitogens and Inhibitors, Significance. Meiosis: Stages, Synaptonemal complex, crossing over and chiasma formation, Significance.	
05	Cell senescence and Cell death: cellular features of Senescence- spontaneous and induced, Programmed cell death, Mechanism of cell death and significance.	
06	Cancer Biology: Introduction to cancer, Benign and malignant, Sarcoma, Carcinoma, Lymphoma and leukemia, Properties of malignant cells.	
Chapter	Unit – 3	14
07	Biography of Mendel and his experiments: Law of Segregation: Monohybrid cross, back cross and Test cross, Genetic Problems related. Law of Independent Assortment: Dihybrid cross, Back cross and Test cross, Genetic Problems related.	
8	Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems related.	
9	Gene Interactions: Deviations from Mendelism: Incomplete inheritance and co-dominance, Complementary gene interaction (9:7), Supplementary gene interaction(9:3:4), Recessive Epistasis, Non-Epistasis (with an example for each trait)	
Chapter	Unit – 4	14
10	Linkage: Linkage definition, cis and trans arrangement of genes, Linkage group in <i>Drosophila</i> and man. Types of linkage – complete and incomplete linkage maps. Linkage map – E.g. <i>Drosophila</i> , construction of linkage maps. Crossing over - Types, mechanism of crossing over, interference and coincidence, Factors affecting linkage and crossing over, significance of linkage and crossing over.	
11	Human Cytogenetics: Normal Human karyotype (Male & Female)	
12	Clinical features and Karyotype of Syndromes: Cri-du-chats, Down's, Edward's, Patau's, Turner's, and Klinefelter's.	

### Text Books:

1. Karp, G. (2009). *Cell and molecular biology: concepts and experiments*. John Wiley & Sons.
2. Russell, P. J., Hertz, P. E., McMillan, B., & Benington, J. (2020). *Biology: the dynamic science*. Cengage Learning.

3. Singh, S. P., & Tomar, B. S. (2008). *Cell biology*. Rastogi Publications, Meerut, India.
4. Cooper, G. M., Hausman, R. E., & Hausman, R. E. (2007). *The cell: a molecular approach* (Vol. 4). Washington, DC: ASM press.
5. Gupta, P.K. (2010). *Cytogenetics*. Rastogi Publications, Meerut, India.
6. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2011). *Lewin's genes X*. Jones & Bartlett Learning.

**References:**

1. Pierce, B. A. (2012). *Genetics: a conceptual approach*. Macmillan publication.
2. Roberts, K., Alberts, B., Johnson, A., Walter, P., & Hunt, T. (2002). *Molecular biology of the cell*. New York: Garland Science.
3. Lodish, Harvey, et al. *Molecular cell biology*. Macmillan, 2008.
4. Snustad, D. P., & Simmons, M. J. (2015). *Principles of genetics*. John Wiley & Sons.

**Pedagogy:**

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Seminars/Assignment/ Minor project	15
Participation in class/ Attendance	05
<b>Total</b>	<b>40</b>



**I SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS  
DISCIPLINE SPECIFIC CORE COURSE– DSCC  
PRACTICAL PAPER: CELL BIOLOGY AND GENETICS/DSCC5GENP1**

Course Title/Code: Cell Biology and Genetics / DSCC5GENP1	Course Credits:02
Total Contact Hours: 56	Duration of MD: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks:25

By the end of the course the students will be able to

1. Learn techniques in cytogenetics
2. Solve problems on mendelian genetics and its deviation
3. Prepare and analyse the karyotype of normal and syndromic individuals.

**Course content**

Paper Code	Practical	Credits:2 Hours 56
MDS GENP 1	<ol style="list-style-type: none"> <li>1. Preparation of pre-treating / fixing agents/ stains for cytological studies.</li> <li>2. Study of Mitosis using root tips</li> <li>3. Study of Meiosis using flower buds/ grasshopper testes</li> <li>4. Preparation of salivary gland chromosomes in <i>Chironomous</i> larvae</li> <li>5. Preparation of salivary gland chromosomes in <i>Drosophila</i> larvae</li> <li>6. Blood typing in humans for multiple alleles and Rh factor</li> <li>7. Histological study of Cancer types using permanent slides</li> <li>8. Genetic Problems on Monohybrid cross,</li> <li>9. Genetic Problems on Dihybrid cross</li> <li>10. Genetic Problems Non-Mendelian Interactions.</li> <li>11. Problems on Linkage and crossing over.</li> <li>12. Interference and coincidence.</li> <li>13. Problems based on construction of genetic map.</li> </ol>	

**Pedagogy:**

<b>Formative Assessment</b>	
Assessment Occasion	Weightage in Marks
House Examination/Test	10
Seminars/Assignment/Minor Project	10
Attendance	05
<b>Total</b>	<b>25</b>

**I SEMESTER B. Sc. GENETICS (HONS) THEORY SYLLABUS**  
**OPEN ELECTIVE OEC**  
**THEORY PAPER: OEC5GENT1: PRINCIPLES OF GENETICS**

Course Title: Principles of Genetics Code: OEC5GENT1	Course Credits:03
Total Contact Hours: 42	Duration of OEC: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks:60

**Course Outcomes (COs):**

Upon successful completion, each student will have the basic knowledge:

1. Historical overview and laws Inheritance.
2. Understand Mendel's principles and deviations.
3. Gene interactions and their outcome through gene mapping.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
VI. Core competency	x											
VII. Critical thinking	x											
VIII. Analytical reasoning	x											
IX. Research skills	x											
X. Team work	x											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark „X” in the intersection cell if a course outcome addresses a particular program outcome.

**Course Content**

Chapter	Content	Hours
	Unit – 1	42
01	<b>History of Genetics:</b> Pre- Mendelian genetic concepts; Concepts of Phenotype and Genotype; Heredity, variation, Pure lines and Inbred Lines Biography of Mendel; Mendelian experiments on pea plants - Law of Segregation; Monohybrid cross, Back cross and Test cross, genetic problems related. Law of Independent Assortment: Dihybrid cross in pea plant, Back cross and Test cross, genetic problems related.	14

02	<b>Multiple Alleles:</b> Definition, ABO blood groups and Rh factor in Human, Genetic Problems related. Deviations from Mendelism - Incomplete inheritance and Codominance; Inter allelic- Complementary gene interaction (9:7) Ex: <i>Lathyrus odoratus</i> ; Supplementary gene interaction (9:3:4) Ex: Grain color in Maize; Epistasis - Dominant Ex.: Fruit color in <i>Cucurbita pepo</i> , Recessive Inheritance-Ex.: Coat color in Mice. Non- Epistasis - Ex.: Comb pattern in Poultry.	
03	<b>Gene mapping:</b> Linkage - Definition, Linkage group- <i>Drosophila and</i> man; Types of linkage-complete linkage and incomplete linkage, Significance of linkage. <b>Linkage maps:</b> Crossing over - definition; recombination and recombination frequency, Mechanism of crossing over: Chiasma Interference and coincidence; Coupling and Repulsion hypothesis.	
Chapter	Unit – 2	14
04	<b>Sex Determination:</b> Chromosome theory of Sex determination: XX- XY, XX-XO, ZZ-ZW; Intersexes and Super sexes in <i>Drosophila</i> , Y chromosome in sex determination of <i>Melandrium</i> .	
05	<b>Genetic and Hormonal control of Sex determination:</b> Genic balance theory of Bridges, Gynandromorphs, Environment and sex determination.	
06	Sex chromosomes and Dosage compensation:	
Chapter	Unit – 3	14
07	<b>Extra Chromosomal Inheritance:</b> Characteristic features of Cytoplasmic Inheritance; Inheritance of- Mitochondrial DNA, Chloroplast DNA, Kappa particles in <i>Paramecium</i> , Sigma factor in <i>Drosophila</i> , Shell coiling in snail.	
08	<b>Behavioral Genetics:</b> Introduction to Genetics and Behaviour, Mating behavior in <i>Drosophila</i> , Hygienic behavior in Honeybee, Nesting behavior in Ants, Territoriality and conflict behavior in Primates.	
09	<b>Microbial Genetics:</b> Transformation, Conjugation, Lytic cycle, Lysogeny, Transduction, Gene mapping by Conjugation and Transduction.	

### Text Books:

1. Concepts of Genetics. Klug, WS., Cummins, MR., Spencer, C., Palladino, MA. 2020. 10th Edition. Pearsons Publication.
2. Genetics: A Conceptual approach. Benjamin A. Pierce. 2000. 7th edition. McMillan Publication.
3. Genetics From Genes to Genomes. Hartwell. L., Michael. L Gold berg., Anne E. Reynolds and Lee. M. Silver. 2009. 4th Edition. Mc Graw Hill Publication.
4. Genetics: Analysis & Principles. Robert J. Brooker 7th Edition. Mc Graw Hill Publication.
5. Genetics: Analysis of Genes and Genomes. Daniel L. Hartl 2014. 5th Edition Jones and Bartlett Publishers. Inc.
6. Principles of Genetics. Snustad Simmons. 2008. 6th Edition. John Wiley Publication.
7. Trun, N., & Trempy, J. (2009). Fundamental bacterial genetics. John Wiley & Sons.
8. Streips, U. N., & Yasbin, R. E. (Eds.). (2004). Modern microbial genetics. John Wiley & Sons.

## References:

1. Advanced Genetics. G. S. Miglani. Alpha Science International, Ltd. 2012.
2. Fundamentals of Biostatistics. 2nd Edition. Khan & Khanum. 2004. Ukaaz publications.
3. Principles of Genetics, 7th Edition, Robert H. Tamarin. 2002. Tata- Mc Graw Hill Publications.
4. Theory and Problems of Genetics. W. D. Stansfield. 2002. Mc Graw Hill Publications.
5. Chromosomal Aberrations: Basic and Applied aspects by Obe.G. and A.T. Natarajan (1990) Springer Verlag, Berlin.
6. Cytogenetics, Plant Breeding and evolution by U.Sinha and Sunita Sinha , Vikas Publishing House Private, Limited, 1998.
7. Cytology, Genetics and Molecular Biology by P.K.Gupta (2002), Rastogi publications.
8. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
9. Genetic Maps, 6th edition by O'Brien, S (1993)
10. Instant notes in Genetics by P.C.Winter, G.I. Hickey and H.L.Fletcher (2003) Viva Books Pvt.Ltd.
11. Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.Wiley and Sons pubs (1998).

## Pedagogy:

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Seminars/Assignment/ Minor project	15
Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	05
<b>Total</b>	<b>40</b>

**I SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS  
SKILL ENHANCEMENT (VOCATIONAL) ELECTIVE COURSES-SEEC  
PRACTICAL PAPER: VEC5GENP1: GENETIC COUNSELING**

Course Title: Genetic Counseling Code: VEC5GENP1	Course Credits: 02
Total Contact Hours: 56	Duration of ESA: 04
Formative Assessment Marks: 25	Summative Assessment Marks: 25

**Course Outcomes (COs):**

At the successful completion of the course students will have

1. Learned methods of genetic testing
2. Mastered pedigree construction, analysis and risk calculation
3. Intensive practical knowledge of Genetic Counseling.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
I. Core competency	x											
II. Critical thinking	x											
III. Analytical reasoning	x											
IV. Research skills	x											
V. Team work	x											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark „X” in the intersection cell if a course outcome addresses a particular program outcome.

Paper Code:	Content	Credit-02 Hours - 56
VEC5GENP1	<ol style="list-style-type: none"> <li>1. Blood grouping and Rh in humans</li> <li>2. Hemoglobin electrophoresis (paper electrophoresis)</li> <li>3. Detection of inborn errors of metabolism–mucopolysaccharidosis, Galactosemia, PKU.</li> <li>4. Human karyotyping</li> <li>5. Demonstration of prenatal diagnosis</li> <li>6. Chorionic villi sampling demo or virtual lab</li> <li>7. Amniocentesis demo or virtual lab</li> <li>8. Demonstration of Ultrasonography</li> <li>9. Scoring dysmorphic features in syndromic patients</li> <li>10. Genetic Counseling methods based on case history</li> <li>11. Construction and analysis of Pedigree</li> <li>12. Risk calculation</li> <li>13. Assessment of inheritance of quantitative characters</li> <li>14. To study the communication process of Genetic counseling for genetic testing.</li> </ol>	

**Textbooks:**

1. Harper, P. (2010). Practical genetic counselling. CRC Press.
2. Kessler, S. (Ed.). (2013). Genetic counselling: psychological dimensions. Academic Press.
3. Stevenson, A. C., & Davison, B. C. (2016). Genetic counselling. Elsevier.
4. Evans, C. (2006). Genetic counselling: a psychological approach. Cambridge University Press.

**References:**

1. Atlas of Inherited Metabolic Diseases.
2. Mendelian Inheritance in Man: A Catalog of Human Genes and Genetic Disorders, Victor A. McKusick,.2 Vol I & II
3. Stacy L Blachford (Editor) 2001. The Gale Encyclopedia of Genetic Disorders. Gale Group Publishers, Vol.1 (A-L), Vol.II(M-Z).
4. Limoine, W.R. and Cooper, D.NB. 1996: Gene Trophy, Bios Scientific Pub.Oxford.

**Databases:**

1. Online Mendelian Inheritance in Man (OMIM)
2. Pictures of Standard Syndromes and Undiagnosed Malformations (POSSUM)
3. London Dysmorphology Database (LDDDB)

Course Books published in English and Kannada may be prescribed by the Universities and College

**Pedagogy:**

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	10
Seminars/Assignment/Minor Project	10
Attendance	05
Total	25

**II SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS  
DISCIPLINE SPECIFIC -DSC**

**THEORY PAPER: DSCC5GENT2- BIOINSTRUMENTATION AND ANIMAL CELL  
CULTURE**

Course Title: Bioinstrumentation and Animal Cell Culture Code: DSCC5GENT2	Course Credits: 04
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

**Course Outcomes (COs):**

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

4. Understand the basic principles of different laboratory equipments.
5. Know the uses of the analytical equipments in various biological applications.
6. Understand the cell lines and culture media and cell culture methods

**Course Content**

	Content	Hours
Chapter	Unit – 1	56
		14
1.	<b>Microscopy:</b> Introduction, and history of Microscopy <b>Principle and Optical Components of microscope:</b> Eye piece, Eye piece tube, Objective lenses, Coarse and Fine Focus knobs, Stage and stage clips, Aperture, Illuminator, Condenser, Condenser Focus Knob, Iris Diaphragm.	
2.	<b>Types of microscopes:</b> Simple and Compound microscopes, Light microscopes, Fluorescence, electron microscopy (transmission and scanning), Phase contrast, Confocal, Stereo microscopy, Optical pathway in different microscopes.	
3.	<b>Uses of microscopy and biological applications:</b> High resolution imaging, immune histochemistry, high-content screening and high-throughput imaging, Medical science, Forensic laboratories.	
Chapter	Unit – 2	14
04	<b>Analytical Instruments: pH meter-</b> principle and components of pH meter. <b>Thermometer:</b> principle, types of thermometers-digital, mercury, strip-type, Infrared, Axillary.	
05	<b>Colorimeter:</b> principles of measurement and applications. <b>Spectrophotometer:</b> Beer-Lambert's Law in spectrometry, UV spectrophotometers, Atomic absorption spectroscopy (AAS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR) Spectrophotometers, Flame photometer.	

06	<b>Different types of sterilization methods:</b> Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.	
Chapters	Unit – 3	14
07	<b>Instruments used in separation techniques:</b> Centrifugation: Principle and applications of centrifuge, types of centrifuge-high speed centrifuge, ultra-centrifuge, Refrigerated centrifuge. Rotors: Types of rotors- vertical, Swing-out, Fixed angle.	
08	<b>Chromatography:</b> Principle, types and application of Chromatography- paper chromatography, ion exchange, gel filtration, HPLC, affinity chromatography.	
09	<b>Electrophoresis:</b> Principle and applications of electrophoresis. Types of electrophoresis: vertical and horizontal. <b>Components:</b> Electrodes, Power supply, electrophoresis chamber	

Chapter	Unit – 4	14
10	<b>Animal cell culture:</b> Principles of cell culture, cell types, cell lines, Primary culture, secondary culture, cryopreservation, contaminations, organotypic culture	
11	<b>Requirements in Animal Cell Culture:</b> Equipments used in Cell culture, Culture vessels, Aseptic techniques. <b>Cell culture media:</b> Natural and defined, role and components of serum in culture. <i>In vitro</i> transformation of animal cells, Types of cell culture.	
12	<b>Applications of cell culture:</b> Cell culture in biomedical research, karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.	



**Text Books:**

1. Alberts B, Johnson A, Lewis J, et al. "Molecular Biology of the Cell", 2002, 4th edition, New York: Garland Science.
2. Lodish H, Berk A, Zipursky SL, et al. "Molecular Cell Biology". 2000, 4th edition. New York: W. H. Freeman.
3. R. Freshney, "Culture of Animal Cells-A Manual of Basic Technique and Specialized Applications", 2015, Seventh edition, Wiley Blackwell.
4. John M. Davis, "Animal Cell Culture: Essential Methods" 2011, John Wiley & Sons Ltd.
5. A. J. Ninfa and D. P. Ballou, *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*, 1998 2<sup>nd</sup> Edition Wiley.
6. J. Sambrook and D. W. Russell, *Molecular Cloning: A Laboratory Manual*, 2001, 3<sup>rd</sup> Edition Cold Spring Harbor Laboratory Press.

**References:**

1. Bronzino, J. D. (1986). Biomedical engineering and instrumentation. PWS Publishing Co...
2. Willard Van Nostrand, "Instrumental Methods of Analysis"-
3. Sharms, "Instrumental Methods", S Chand & Co.
4. Harry Bronzino E, "Handbook of Biomedical Engineering and Measurements", Reston, Virginia.
5. Jacobson & Websler, "Medicine & Clinical Engg"
6. Leslie Cromwell, "Biomedical Instrumentation and Measurements"
7. Geddes & Baker, "Principles of Applied Biomedical Instrumentation" Wiley.

Course Books published by College teachers may be used

**Pedagogy:**

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Seminars/Assignment/ Minor project	15
Attendance	05
Total	40

**II SEMESTER B.SC., GENETICS (HONS) PRACTICAL SYLLABUS  
DISCIPLINE SPECIFIC CORE COURSE - DSCC  
PRACTICAL PAPER: DSCC5GENP2: BIOINSTRUMENTATION AND ANIMAL  
CELL CULTURE**

Course Title: Bioinstrumentation and Animal Cell Culture Code: DSCC5GENP2	Course Credits: 02
Total Contact Hours: 56	Duration of ESA: 4 Hours
Formative Assessment Marks: 25	Summative Assessment Marks: 25

**Course Outcomes (COs):**

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

1. Understand the lab safety and maintenance of different laboratory equipments.
2. Operate different laboratory equipments.
3. Handle and culture different cell lines.

**Course Content**

**56 hrs.**

1. Demonstration of optical Components of microscope: Eye piece, Eye piece tube, Nose piece, Objective lenses, Coarse and Fine Focus knobs, Stage and stage clips, Aperture, Illuminator, Condenser, Condenser Focus Knob, Iris Diaphragm.
2. Fluorescence Microscopy: viewing cells stained with fluorescent dyes.
3. Demonstration experiments on, laser scanning, Phase contrast, confocal and scanning electron microscopy.
4. Preparation of buffers using pH meter.
5. Temperature recording using Thermometer
6. Colorimetric estimation of proteins
7. Protein estimation by Bradford reagent method.
8. Demonstration of Beer-Lambert's Law in spectrometry
9. Recording ultraviolet absorption spectra for DNA
10. Demonstration of UV spectrophotometers, Atomic absorption spectroscopy, Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR) Spectrophotometers, Flame photometer.
11. Chromatography: size exclusion chromatography of a crude mixture of proteins using standard matrix and dyes
12. Demonstration of components of different centrifuges. Rotors: Types of rotors- vertical, Swing-out, Fixed angle.
13. Agarose electrophoresis of DNA
14. SDS-PAGE electrophoresis of proteins
15. Demonstration of cell culture and cell lines.
16. Demonstration of sterilization methods: Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.

**Text Books:**

1. Alberts B, Johnson A, Lewis J, et al. "Molecular Biology of the Cell", 2002, 4th edition, New York: Garland Science.
2. Lodish H, Berk A, Zipursky SL, et al. "Molecular Cell Biology". 4th edition. New York: W. H. Freeman; 2000.
3. R. Freshney, "Culture of Animal Cells-A Manual of Basic Technique and Specialized Applications", 2015, Seventh edition, Wiley Blackwell.
4. John M. Davis, "Animal Cell Culture: Essential Methods" 2011, John Wiley & Sons Ltd.
5. A. J. Ninfa and D. P. Ballou, *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*, 1998 2<sup>nd</sup> Edition Wiley.
6. J. Sambrook and D. W. Russell, *Molecular Cloning: A Laboratory Manual*, 2001, 3<sup>rd</sup> Edition Cold Spring Harbor Laboratory Press.

**References:**

1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engg . , Boston.
2. Willard Van Nostrand, "Instrumental Methods of Analysis"-
3. Sharms, "Instrumental Methods", S Chand & Co.
4. Harry Bronzino E, "Handbook of Biomedical Engineering and measurements", Reston, Virginia.

Course Books published by College teachers may be used

**Pedagogy:**

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	10
Seminars/Assignment/Minor Project	10
Active learning/Problem based/Review Writing/ Paper presentation	05
Total	25

**II SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS  
OPEN ELECTIVE COURSE-OEC  
THEORY PAPER: OEC5GENT2: GENETIC COUNSELLING**

Course Title/Code: Genetic Counselling / OEC5GENT2	Course Credits:03
Total Contact Hours: 42	Duration of OEC: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Outcomes (COs):

Upon successful completion, each student will have the basic knowledge of

1. Genetic counselling methods
2. Reproductive risk calculation
3. Ethical and legal issues of genetic counselling

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
I. Core competency	x											
II. Critical thinking	x											
III. Analytical reasoning	x											
IV. Research skills	x											
V. Team work	x											

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark „X’ in the intersection cell if a course outcome addresses a particular program outcome.

Course Content:

Chapter	Content	Hours
		42
	Unit – 1	14
01	<b>Genetic Counselling:</b> Introduction; Historical over view, types and scope. Counsellor: Definition, Role, Qualities and responsibilities; Consultant- Definition, needs, Rights.	
02	<b>Individual counselling:</b> Definition, objectives, important issues in genetic counselling, Counselor’s background, cultural knowledge, health benefits, family issues, building rapport, empathy in family.	

03	<b>Group counselling:</b> Definition, objectives, types of groups, theoretically oriented group counselling; Behavioral counselling; Transactional counselling; Group crisis intervention. Family counselling – Definition, objectives, selecting family therapy as the method of choice, family counselling theories and psychoanalytical therapies.	
Chapter	Unit – 2	14
04	<b>Process of Genetic Counselling:</b> Information gathering, medical evaluation, Physical examination and investigations. Medico legal case - Diagnosis based on medical history (Past medical, social and family history); Risk <b>Psychological aspects of counselling:</b> assessments – Communication, discussion of options.	
05	<b>Psychological aspects of counselling:</b> Role of social workers; Nutritional; occupational; Physical; Speech therapist; Psychologists and school professional in genetic counselling. Educating the consultant; Presenting the Risks, Options and Guiding; Diagnostics problems in Genetic counselling; Indications for genetic counselling and genetic counselling case management	
06	<b>Reproductive risk assessments:</b> Reproductive failures; consanguinity; endogamous marriages and its impact on genetic disorders.	
Chapter	Unit – 3	14
07	<b>Registries for Genetic Counselling:</b> Registries and support groups for rare medical disorders; Principles of predictive counselling and testing in late onset disorders imparting results of predictive testing; Counselling and management in follow up sessions.	
08	Ethical concerns in genetic counselling: Ethical issues in testing of minors; Prenatal diagnosis in late onset disorders; Ethical, legal and social issues (ELSI).	
09	<b>Acts and amendments:</b> The medical termination of pregnancy act 1971; The Pre- natal diagnostic techniques act 1994; Regulatory bodies of Genetic counselling – BGCI (India); ABGC (USA); CAGC (Canada).	

**Text books:**

1. Doing a literature review in health and social care: a practical guide, Helen Aveyard (2014).
2. Doing your research project: a guide for first-time researcher, Judith Bell with Stephen Waters (2014).
3. Facilitating the genetic counseling process: practice-based skills. Patricia McCarthy Veach, Bonnie S. LeRoy and Nancy P. Callanan (2018).

4. Family communication about genetics: theory and practice, Clara L. Gaff and Carma L. Bylund (2010).
5. Foundations of perinatal genetic counseling: a guide for counselors, Amber Mathiesen and Kali Roy (2018).
6. Gardner and Sutherland's chromosome abnormalities and genetic counselling, R.J. McKinlay Gardner and David J. Amor (2018).
7. Genetic counseling: ethical challenges and consequences, Dianne M. Bartels, Bonnie S. LeRoy, and Arthur L. Caplan (2011).
8. Genetic counseling for adult neurogenetic disease: a casebook for clinicians, Jill S. Goldman (2015).
9. Genetic counseling research: a practical guide, Ian M. MacFarlane, Patricia McCarthy Veach, Bonnie S. LeRoy (2014).
10. A guide to genetic counselling, edited by Wendy R. Uhlmann, Jane L. Schuette, Beverly M. Yashar (2009).

**References:**

1. Helping the client: a creative practical guide, John Heron (2001).
2. How to read a paper: the basics of evidence-based medicine, Trisha Greenhalgh (2014).
3. Make it stick: the science of successful learning, Peter C. Brown, Henry L. Roediger and Mark A. McDaniel (2014).
4. Normative and pragmatic dimensions of genetic counseling: negotiating genetics and ethics, Joseph B. Fanning (2016).
5. Practical genetic counselling, Peter S. Harper (2010).
6. Thompson & Thompson genetics in medicine, Robert L. Nussbaum, Roderick R. McInnes, Huntington F. Willard, Ada Hamosh (2016).

**Pedagogy:**

Formative Assessment	
Assessment Occasion	Weightage in Marks
House Examination/Test	20
Seminars/Assignment/ Minor project	15
Active learning/Problem based/Review Writing/ Paper presentation/ Case studies	05
<b>Total</b>	<b>40</b>

**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	22	40	25	9	25	3	4	150	4	2
		Open elective	42	3	-	60	22	40	-	-	-	3	4	100	3	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	4	50	-	2
2	II	CORE subject	56	4	4	60	22	40	25	9	25	3	4	150	4	2
		Open elective	42	3	-	60	22	40	-	-	-	3	4	100	3	-
		Skill Enhancement Course	56	-	4	-	-	-	25	9	25	3	4	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
	<b>TOTAL Theory IA Marks</b>	<b>40</b>

**Scheme of Internal Assessment: Marks Practicals**

Sl. No.	Particulars	IA Marks
1	Practical Test	05
2	Submission of Project Report	05
3	Viva-voce on project report	05
4	Active participation in practical classes (Attendance)	05
5	Practical Record(s)	05
	<b>TOTAL Theory IA Marks</b>	<b>25</b>

**I semester B.Sc. Genetics (HONS) Major core course-1**  
**SCHEME OF PRACTICAL EXAMINATION**  
**Practical Paper: Cell Biology and Genetics (DSCC5GENP1)**

Duration: 3Hrs Max. Marks: 25

1. Prepare a temporary squash of the onion root tip. Identify and comment on the stages with neat labeled diagram. (Mitosis). **(6 Marks)**

OR

- Prepare a temporary squash of the Onion flower bud/ Grasshopper Testis. Identify and comment on the stages observed.
2. Prepare the Polytene chromosome from the given material (Drosophila Larvae/ Chironomous Larvae) and comment with a neat labelled diagram **(6 Marks)**
3. Perform the blood typing and interpret the result. **(6 Marks)**
4. Solve the Genetic Problems **(3.5 X 2=7 marks)**
  - a. problem on Linkage
  - b. problems on calculation of interference and construction of Genetic map

**I semester B.Sc. Genetics (HONS) Minor discipline course-1**  
**SKILL ENHANCEMENT (VOCATIONAL) ELECTIVE COURSES-SEEC**  
**PRACTICAL PAPER: VEC5GENP1: GENETIC COUNSELING**  
**PRACTICAL EXAMINATION**

Duration: 3Hrs Max. Marks: 25

1. Separate hemoglobin by Paper electrophoresis **(6 marks)**
  2. Construct the pedigree for the given data /analyse the given pedigree **(6 marks)**
  3. Detect the blood group of the given sample and comment on the result **(4 marks)**
  4. Analyse the given case history and assess the risk of occurrence. **(4 marks)**
  5. Identify and comment on the given spotters (a &b). **(2.5 X 2) (5 marks)**
- 

**II semester B.Sc. Genetics (HONS) Minor discipline course-1**  
**SCHEME OF PRACTICAL EXAMINATION**  
**Practical Paper: Medical Genetics (MDC5GENP2)**

Duration: 3Hrs Max. Marks: 25

1. Isolate DNA/RNA from Human blood. **(8 Marks)**

OR

- Separation of DNA/RNA by electrophoresis.
2. Separate Hemoglobin by paper electrophoresis. **(8 Marks)**
3. Estimate the amount of DNA/RNA by spectrophotometric method. **(6 Marks)**
4. Analyze/ construct Pedigree or Blood group assessment/ Spotters (Karyotype) **(3 Marks)**

**II semester B.Sc. Genetics (HONS) Minor discipline course-1**  
**SCHEME OF PRACTICAL EXAMINATION**  
**Practical Paper: Bioinstrumentation and animal cell culture (DSCC5GNP2)**

Duration: 3Hrs Max. Marks: 25

1. Separate DNA by Agarose Gel electrophoresis. **(8 Marks)**

OR

  - Separate Protein by SDS Page
  2. Estimate the amount of Protein present in the given sample by Bradford's method **(8 Marks)**
  3. Write the working principle and application of (Microscopy / Spectrophotometer / Centrifuge) **(3X2 =6 Marks)**
  4. Prepare a buffer for the given pH. **(3 Marks)**
-



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

<b>IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka</b>							
<b>Example: Bachelor of Science (Basic/Hons.) (with Genetics &amp; Botany as subjects with practicals) with one major and one minor</b>							
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"> <li>The structure and functions of animal cell, cell organelles, cell- cell interactions, process of reproduction leading to new organisms.</li> <li>The principles of inheritance, Mendel's laws and the deviations.</li> <li>Inheritance of chromosomal aberrations in humans by pedigree analysis in families.</li> </ol>	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"> <li>Learn the systematics and biology of non-chordates through their adaptive features.</li> <li>Study the functional biology of non-chordates through their body organization.</li> <li>Comprehend identification of species and their evolutionary relationships.</li> </ol>	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"> <li>Acquaint the knowledge about basic procedure and methodology of integrated animal rearing.</li> <li>Students can start their own business i.e. self- employments.</li> <li>Get employment in different sectors of Applied Zoology</li> </ol>	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	<b>SEC 1 Digital fluency</b> 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"> <li>In depth understanding of structure of biomolecules like proteins, lipids and carbohydrates.</li> <li>The thermodynamics of enzyme catalyzed reactions.</li> <li>To know various physiological processes of animals.</li> </ol>	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"> <li>1. Learn the systematics and biology of Chordates through their adaptive features.</li> <li>2. Study the functional biology of Chordates through their body organization.</li> <li>3. Comprehend identification of Chordate species and their evolutionary relationships.</li> </ol>	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	<b>Environmental Studies</b> Sericulture(2)	<ol style="list-style-type: none"> <li>1. Sericulture is an agro-based industry which gives economic empowerment to the students.</li> <li>2. Sericulture may be taken up as a small scale industry by the small farmers and unemployed youth.</li> <li>3. Get jobs in teaching</li> </ol>	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,
<b>EXIT OPTION WITH CERTIFICATE (50 CREDITS)</b>						

## 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
<b>Exit option with certificate in Genetics(50credits)*</b>			
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
<b>Exit option with Diploma in Genetics(100credits)*</b>			
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"> <li>1. Understand the structure and function of all the cell organelles.</li> <li>2. Know about the chromatin structure and its location.</li> <li>3. Understand the Mendel's laws and its deviations.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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"> <li>1. Understand relationship between food, microbiome, genome and epigenome.</li> <li>2. Know how a plateful of meal can control metabolism, prevent diseases and improve health.</li> <li>3. Learn importance of nutritional defects of adulterants.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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"> <li>1. Study historical overview and laws of Inheritance.</li> <li>2. Understand Mendel's principles and deviations.</li> <li>3. Gene interactions and their outcome through gene mapping.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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"> <li>1. Learning methods of genetic testing</li> <li>2. understanding pedigree construction, analysis and risk calculation</li> <li>3. intensive practical knowledge of Genetic Counseling.</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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"> <li>1. Understand the basic principles of different laboratory equipments.</li> <li>2. Know the uses of the analytical equipments in various biological applications.</li> </ol> <p>Understand the cell lines and culture media and cell culture methods</p>	Life science Studied as of the options in 12 <sup>th</sup> 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"> <li>1. Understand genetic basis of human diseases and disease gene identification</li> <li>2. Have insight of techniques used in medical genetics</li> <li>3. Have thorough knowledge of gene therapy and its strategies</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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"> <li>1. Genetic counselling methods</li> <li>2. Reproductive risk calculation</li> <li>3. Ethical and legal issues of genetic counselling</li> </ol>	Life science studied as of the options in 12 <sup>th</sup> 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: <b>Biomolecules and Molecular Genetics</b>
Course Code:	Course Type: <b>DSCC5GENT3</b>
Course Credits	4
Total hours :	56
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
Duration of DSC	<b>4Hours</b>

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



<p><b>Unit 2: Chemical basis of Heredity</b></p> <p><b>a. Introduction:</b> DNA (Hershey and Chase experiment) and RNA (Fraenkel and Singer experiment) as genetic material.</p> <p><b>b.</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><b>c.</b> 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><b>Unit 3: Protein synthesis and gene regulation</b></p> <p><b>a.</b> 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>b.</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><b>Unit 4: Transposons, Mutations and DNA repair mechanism</b></p> <p><b>a.</b> Transposons - IS elements in bacteria, p elements in <i>Drosophila</i>, AC-DS in Maize;</p> <p><b>b.</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><b>c.</b> 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: <b>DSCC5GENP3</b>
Course Credits:	2
Total contact hours : <b>56 hrs.</b>	Duration of MD: <b>4 Hours</b>
Formative Assessment Marks: <b>25</b>	Summative Assessment Marks: <b>25</b>

## 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: <b>Eugenics, Euphenics and Society</b>
Course Code:	<b>OEC5GENT3</b>
Course Credits:	3
Total hours :	42
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>

**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><b>Unit 1: Introduction to Eugenics</b>  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><b>Unit 2: Prenatal diagnosis</b>  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><b>Unit 3: Gene therapy</b>  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, 6<sup>th</sup> edition, Books and Allied (P), Ltd
4. Foundations of perinatal genetic counseling: a guide for counselors, Amber Mathiesen and Kali Roy (2018).
5. Rimoin 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: <b>Human Genetics and Genetic Counselling</b>
Course Code:	Course Type: <b>DSCC5GENT4</b>
Course Credits	4
Total hours :	<b>56</b>
Formative Assessment Marks: <b>40</b>	Summative Assessment Marks: <b>60</b>
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><b>UNIT I: Human chromosomes and chromosomal Inheritance Pattern</b></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><b>Unit 2: Immunogenetics</b></p> <p><b>a. Introduction to immunology-</b> types and properties of antigens, antibodies, B and T Cells, Immunity types - Innate and acquired. Immune response - Humoral and Cell mediated,</p> <p><b>b.</b> Genetics of immune system – antibody gene rearrangement and class switching. Inherited immunodeficiency- Ex. X- linked agammaglobulinaemia.</p> <p><b>c.</b> Major Histocompatibility Complex- Types, HLA disease associations. Transplantation, graft-rejection and immunosuppressors Concept of immunization</p>	14
<p><b>Unit 3: Prenatal diagnosis and gene therapy</b></p> <p><b>a.</b> 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>b.</b> Gene therapy with reference to SCID Stem cells- Properties, types and sources. Cord blood banking and Stem cell therapy</p>	14
<p><b>Unit 4: Genetic Counselling:</b></p> <p><b>a.</b> Symbols used in pedigree studies, Pedigree construction and analysis, Pedigree analysis for the inheritance pattern of genetic diseases,</p> <p><b>b.</b> Genetic Counseling. –Introduction to Genetic counseling; Historical over view, Stage of counseling, scope of Genetic counselling.</p> <p><b>c.</b> 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 Turnpenney, 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><b>Unit 1:</b> 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><b>Unit 2:</b> 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><b>Unit 3: Single gene disorder, complex disorder and gene therapy</b>            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	<b>CORE subject</b>	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		<b>Open elective</b>	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		<b>Skill Enhancement Course</b>	56	-	4	-	-	-	25	9	25	3	3	50	-	2
2	II	<b>CORE subject</b>	56	4	4	60	21	40	25	9	25	3	3	150	4	2
		<b>Open elective</b>	42	3	-	60	21	40	-	-	-	2.5	-	100	3	-
		<b>Skill Enhancement Course</b>	56	-	4	-	-	-	25	9	25	3	3	50	-	2

### Scheme of Internal Assessment Marks: Theory

<b>Sl. No.</b>	<b>Particulars</b>	<b>IA Marks</b>
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
	<b>TOTAL Theory IA Marks</b>	<b>40</b>

### Practicals:

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

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

**Duration: 3 hours**

**Max. marks: 25**

- |  |      |
|--|------|
| 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

---000---

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

**Duration: 3 hours**

**Max. marks: 25**

- |  |     |
|--|-----|
| 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<br>(ODD/RID/Dot ELISA) | 04M |

TOTAL Marks 25M

-----