

ಡಾ. ಮನಮೋಹನ್ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

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No.MSBCU/BoS/Syllabus/Science/ 107 /2026-27

Date: 29.06.2026

NOTIFICATION

Sub: Syllabus for the V & VI Semester Under Graduate Courses in the Faculty of Science -reg

- Ref: 1. Government Order No. ED 166 UNE 2023 Bengaluru dated. 08.05.2024
2. Recommendations of the Boards of Studies in the Faculty of Science
3. Approval of the Academic Council in its meeting held on 08.06.2026
4. Orders of Vice-Chancellor dated.29.06.2026

The Syllabus prepared by the Boards of Studies for the different Subjects of V & VI semester Under Graduate Courses, in the faculty of Science based on the Guidelines and Curriculum Structure issued by the Government under ref(1) have been approved by Academic Council meeting held on 08.06.2026.

Accordingly, the CBCS Syllabus for the V & VI Semester UG Courses of Science Faculty in respect of following subjects are hereby notified for implementation from the academic year 2026-27.

Sl. No.	Subjects
1.	Botany– V & VI Semester
2.	Chemistry– V & VI Semester
3.	Zoology and Genetics– V & VI Semester
4.	BoS in Fashion and Apparel Design i. FAD – V & VI Semester ii. IDD– V & VI Semester
5.	Geography– V & VI Semester
6.	Mathematics– V & VI Semester
7.	Physics – V & VI
8.	BoS in Home Science i) Home Science – V & VI ii)Nutrition & Dietetics – V & VI iii)Clinical Nutrition & Dietetics – V & VI iv)Food Technology – I & II Sem

p.t.o

9.	Criminology and Forensic Science– V & VI
10.	Psychology– V & VI Semester
11.	Electronics – V & VI
12.	Statistics – V & VI
13.	Microbiology– V & VI
14.	Biotechnology– V & VI
15.	Environmental Science– V & VI

The detailed Syllabi for above subjects are notified in the University Website:
www.bcu.ac.in for information of the concerned.


REGISTRAR

Copy to;

1. The Registrar(Evaluation), Dr. Manmohan Singh Bengaluru City University
2. The Dean, Faculty of Science, MSBCU.
3. The Principals of the concerned affiliated Colleges of MSBCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in



Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
[As per SEP]

Syllabus for B.Sc.
Genetics

2026-27 onwards

**Dr. MANMOHAN SINGH BENGALURU CITY UNIVERSITY
BENGALURU**

PROCEEDINGS OF THE MEETING OF BOS (UG) IN ZOOLOGY AND GENETICS

Ref: 1) BCU/BOS/SEP/376/2024-25 Dated 29-01-2025

2) BCU/Syn/BOS/Zoology & Genetics (UG)/404/2024-25 Dated 03-03-2025

The Chairperson- BOS in Zoology / Genetics, Dr. Manmohan Singh Bengaluru City University, Bengaluru greeted the BOS Members before the commencement of the meeting

A meeting of Board of Studies in Zoology and Genetics of BCU was held on 18th and 19th February 2026 (during 10.30Am to 4.30pm) at Department of Zoology, Bangalore University, Jnanabharathi Campus, Bengaluru to scrutinize the drafted syllabus pertaining to B.Sc., Zoology and Genetics, Dr. Manmohan Singh Bengaluru City University, Bengaluru in accordance with SEP- 2024.

Agenda 1: Approval of syllabi for 5th and 6th semester B.Sc., Zoology and B.Sc., Genetics under SEP-2024:

Resolution: The proposed syllabus for 5th and 6th semester B.Sc., Zoology and B.Sc., Genetics (both theory and practical) and as well as the scheme of examination were scrutinized thoroughly, finalized with appropriate inclusion(s) and deletion(s) of the contents and finally approved on 19th February 2026.

Agenda 2: Approval of panel of examiners for B.Sc., Zoology and B.Sc., Genetics for the academic year 2026-2027:

Resolution: The given panel of examiners for UG Zoology and Genetics for the year 2026-2027 were scrutinized thoroughly, finalized with appropriate inclusion(s) and deletion(s) of the contents and finally approved.

The meeting was concluded with the chairperson thanking all the members for rendering cooperation for the smooth conduct of the meeting.

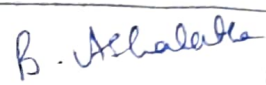
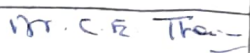
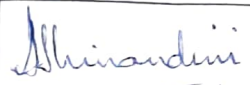
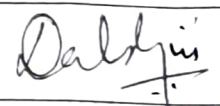
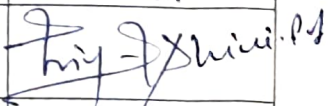
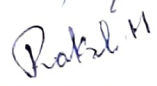
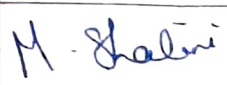
Thanking You


(B.P. HARINI)

BOS Chairperson

Dr. Manmohan Singh Bengaluru City University
Bengaluru

The following BOS Members attended the meeting:

Sl.No.	Members	Designation	Signature
1.	Dr. B.P. Harini, Professor, Department of Zoology, Bangalore University, JB Campus, Bengaluru (Ph.No.9448939066)	Chairperson	
2.	Dr. Ashalatha, Assoc. Professor, Department of Zoology, Vijaya College, RV Road, Bengaluru, (Ph.No. 9480019720)	Member	
3.	Dr. C.E. Thriveni, Assoc. Professor, VV Puram College of Science, Bengaluru (Ph.No. 9902452934)	Member	
4.	Dr. Shubha. M., Assoc. Professor, BMS College for Womens, Basavagudi, (Ph.No. 9900782822)	Member	
5.	Dr.SalmaBanu., Associate Professor, Sheshadripuram First Grade College, Yelahanka (Ph.No. 9886703351)	Member	
6.	Dr. T.N. Ramakrishnaiah., Associate Professor, Department of Genetics, M.S.Ramaiah College, Bengaluru, (Ph.No. 9611928200)	Member	
7.	Dr. Abhinandini., Professor, Maharani's Science college for Women, Mysuru (Ph. No.9964123301)	Member	
8.	Dr. Bhushanam., M., Professor, Department of Zoology, Maharani Cluster University, Bengaluru (Ph. No. 8861921326)	Member	
9.	Dr. Dakshayini, P.N., Professor, Department of Zoology, Maharani Cluster University, Bengaluru (Ph. No. 9740809805)	Member	
10.	Dr. Anil.G.B. , Assistant Professor, MES Degree college, Malleshwaram, Bengaluru (Ph. No. 9611325084)	Member	
11.	Dr. Priyadarshini.P.A Associate Professor, Vijaya college, R.V road,Basavanagudi Bengaluru (Ph. No. 9886555917)	Co-opt Member	
12.	Dr. Rakesh, H., Teaching Faculty, Department of Zoology, Bangalore University, JB Campus, Bengaluru(Ph. No. 9916311539)	Co-opt Member	
13.	Dr. Shalini.M ., Teaching Faculty, Centre for Applied Genetics, Bangalore University, JB Campus, Bengaluru(Ph. No. 8050663448)	Co-opt Member	


Dr. B.P. HARINI

Professor

Chairperson- BOS in Zoology & Genetics (UG/PG)

Dr. Manamohan Singh Bengaluru City University, Bengaluru-560001

FOREWORD

As per the recommendations made by State Education Policy (SEP) led by Prof. Sukhdeo Thorat commission, the Government of Karnataka has reinforced the three-year degree programme from the academic year 2024-25. The new changes come close on the heels of students and colleges who have expressed concerns over the lack of clarity in pursuing a four-year programme as per NEP. As per the recommendations, now colleges can offer degrees with three majors with a general degree in all six semesters; three majors up to fourth semester, and specialization in one subject in fifth and sixth semester or; a single subject specialization from first semester with minors. In addition to majors and specialization courses, the three subjects will be compulsory. First a course with practical (skill) orientation which is linked to the theoretical major course and is expected to improve employability. Students have to learn two languages: Kannada/ other Indian languages, and English. The third compulsory subject is value or moral education which will include teaching constitutional moral values/ principles of equality, liberty, fraternity, national unity, non-discrimination and similar values. Two electives that can be selected by the students based on the availability of courses may be discipline based or distinctly related to discipline-based majors. It is recommended that a tutorial or assignment with a project component based on the survey which will give or involve practical experience may be included. It is also suggested that skill enhancement course with a tutorial based on the survey/laboratory be introduced for single subject specialization and deep specialization in 5th and 6th semesters. The examination pattern will be 80:20-80 for the semester-end exam, and 20 for internal assessment. Likewise, for practical oriented science subjects, the examination pattern will be 40:10-40 for the semester-end practical exam, and 10 for internal assessment.

The prominent features of the new scheme framework are:

1. Colleges can offer degrees with three majors - three majors up to fourth semester, and specialization in one subject in fifth and sixth semester or; a single subject specialization from first semester with minors. In addition to majors and specialization courses, the three subjects will be compulsory.
2. Students have to learn two languages: Kannada/other Indian languages, and English.
3. The third compulsory subject is value or moral education which will include teaching constitutional moral values/ principles of equality, liberty, fraternity, national unity, non-discrimination and similar values.
4. Two electives that can be selected by the students based on the availability of courses may be discipline based or distinctly related to discipline-based majors.

I am delighted to present curriculum structure pertaining to B.Sc., Degree in subject Genetics. I hope that the curriculum structure and syllabus will pave the way for overall development of the student community. I ensure that, students' community will procure the benefits at large in higher education.



Dr. B. P. HARINI
Chairperson-BOS (UG) in
Zoology & Genetics
Dr. Manmohan Singh
Bengaluru City University

DR. MANMOHAN SINGH BENGALURU CITY UNIVERSITY**DEPARTMENT OF GENETICS****Credit framework for Science Stream (B. Sc.) with 3-major subjects (3 + 2 C)**

Semester	CORE-1 (T + P)	CORE-2 (T + P)	CORE-3 (T + P)	Elective (E)	Languages (1 & 2)	Compulsory Skill	Total credits
I semester	3 +2 = 5	3 +2 = 5	3 +2 = 5		L-1= 3 L-2= 3	C-1 (Constitution Values) = 2	23
II semester	3 +2 = 5	3 +2 = 5	3 +2 = 5		L-1= 3 L-2= 3	C-2 (Constitution Values + Environment al Studies) = 4	25
III semester	3 +2 = 5	3 +2 = 5	3 +2 = 5	E-1= 2	L-1= 3 L-2= 3		23
IV semester	3 +2 = 5	3 +2 = 5	3 +2 = 5	E-2= 2	L-1= 3 L-2= 3	Skill-1 = 2 (Pr.knowd.)	25
V semester (2 T^^ + 1 P)	3 +2 = 5 3 +0 = 3	3 +2 = 5 3 +0 = 3	3 +2 = 5 3 +0 = 3			Skill-2 = 2 (Pr.knowd.)	26
VI semester (2 T^^ + 1 P)	3 +2 = 5 3 +0 = 3	3 +2 = 5 3 +0 = 3	3 +2 = 5 3 +0 = 3			Skill-3 = 2 (Pr.knowd)	26
Total	36	36	36	4	24	10	148

All numerical may read as credits

Note- **(Two theory): 2 T ^^** with approval from Academic bodies.

DR. MANMOHAN SINGH BENGALURU CITY UNIVERSITY
DEPARTMENT OF GENETICS
PROPOSED CURRICULUM SUBJECTS FOR B. Sc. Genetics (UG) 2025-26

Sem	Paper Code	Title of the paper	Total no. of hours	Hours /Week	Marks	Internal Assessment *	Total Marks	Credits
I	DSCGT-1	Cell Biology	56	04	80	20	100	3
	DSCGP-1	Practical Cell Biology	45	03	40	10	50	2
II	DSCGT-2	Cytogenetics	56	04	80	20	100	3
	DSCGP-2	Practical Cytogenetics	45	03	40	10	50	2
III	DSCGT-3	Molecular Genetics	56	04	80	20	100	3
	DSCGP-3	Practical Molecular Genetics	45	03	40	10	50	2
	<i>Elective-1 DSGE-1</i>	<i>Clinical Genetics</i>	45	03	40	10	50	2
IV	DSCGT-4	Developmental Genetics	56	04	80	20	100	3
	DSCGP-4	Practical Developmental Genetics	45	03	40	10	50	2
	<i>Elective-2 DSGE-2</i>	<i>Bioinstrumentation</i>	45	03	40	10	50	2
	SKILL -1: DSGS-1	SKILL ENHANCEMENT COURSE -1: Laboratory Diagnosis in Genetics	45	02	10	40	50	2
V	DSCGT5	Human Genetics	56	04	80	20	100	3
	DSCGT6	Population and Evolutionary Genetics	56	04	80	20	100	3
	DSCGP5	Human Genetics & Population and Evolutionary Genetics	45	03	40	10	50	2
	SKILL-2: DSGS2	SKILL ENHANCEMENT COURSE -2: Molecular tools in Genetics	45	02	10	40	50	2
VI	DSCGT7	Genetic Engineering	56	04	80	20	100	3
	DSCGT8	Applied Genetics	56	04	80	20	100	3
	DSCGP6	Genetic Engineering & Applied Genetics	45	03	40	10	50	2
	DSGS-3	Project/Intersip	45	02	10	40	50	2

NOTE:

- Internship shall be discipline specific of 90 hours (2credits) with a duration of 4 to 6 weeks.
- Internship may be fulltime or part time (FT during semester holidays in the academic session).
- Internship mentor/Supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- The students should submit the final internship report (90 hours of internship) to the mentor for the completion of the internship.
- The detailed guideline and formats shall be formulated by the universities separately as prescribed in accordance to UGC guidelines.

Internship for the graduate program as per UGC guidelines

Course Title	Discipline specific
No. of Contact hours	90
No. of Credits	2
Method of Evaluation	Report submission + Presentation and Viva

Syllabus for B.Sc., in Genetics

Introduction

The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Genetics and allied courses, as well develop scientific orientation, spirit of enquiry problem solving skills and human and professional values which foster rational and critical thinking in the students. This course serves as plethora of opportunities in different fields right from classical to applied Genetics.

PROGRAM SPECIFIC OUTCOMES IN B.Sc., Genetics (UG)

PSO1-Understand and correlate the concepts of cytology, cytogenetics, Molecular genetics, Human Genetics, Gene Regulation, Developmental Genetics, Plant and Animal cell culture and Applicative Genetics.

PSO2- Understand the basic principles and develop skills for using various Laboratory and analytical instruments and equipment.

PSO3- Perform practical as per laboratory standards in Cytology, cytogenetics, molecular genetics, Human genetics, Developmental genetics, Plant and Animal Cell culture and applicative Genetics.

PSO4- Adapt to Interdisciplinary approach of science.

PSO5- Teamwork and leadership skills including group analysis of data, working together in the research laboratory, joint compositions of written reports, substantive participation in research group meetings, etc.

PSO6- Contributes the knowledge for Nation building.

Program Outcomes:

PO1 – Students can gain knowledge on various structure and function of cell organelles.

PO2 –Understand and apply the basic principles and applications of cytogenetics.

PO3 – Comprehend the structure and function of gene. Understand and analyse the organization of genetic material in prokaryotes and eukaryotes.

PO4 – Apply the knowledge and understand the inheritance pattern of genetic diseases, its diagnosis and current trend of treatment and control measures, gain insight to immunology.

PO5 – Understand the role of genes in Plant and animal development and correlate the recent advances in clinical embryology.

PO6 –Comprehend the genetics basis of evolution.

PO7 – Understand and apply various biometrical, computational tools in genetics, Apply the knowledge of genetics in Diagnostics and Genetic Engineering.

PO8 – Apply the knowledge of Genetics in Research and development, crop improvement and Animal welfare. Understanding the role of genetic principles in biotechnology, pharmaceuticals and other fields.

Graduate Attributes in B.Sc. Genetics

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

Develop fundamental skills required to enter the professional world of Genetics.

Adapt and appreciate interdisciplinary approach of Research.

Efficient communication, Critical thinking and problem-solving capacity.

Ethical awareness / reasoning.

Outline of blue-print of the question papers to be prepared (% of share in each category proposed by GOVT.)

THEORY

• Short answer questions: 20%	2x 10 =20
• Explanatory questions: 40%	
(To test overall understanding of subject):	6 x 5 =30
Essay type questions: 40% 30	<u>3 x 10 = 30</u>
Total Marks:	80
	IA marks: 20
Total	100

PRACTICALS

Total Practical exam Marks:	40
<u>IA marks:</u>	<u>10</u>
Total:	50

V SEMESTER B.SC., GENETICS THEORY SYLLABUS

PAPER V: HUMAN GENETICS

Course Description

Program Name:	B.Sc., Genetics	Semester:	V
Course Title:	Human Genetics (Theory)		
Course Code:	DSCGT5	No. of Credits:	3
Contact hours:	56 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	4 hrs
Formative Assessment Marks:	20	Summative Assessment Marks:	80

Course Out comes (COs): After the successful completion of the course, the student will be able to:

CO1: understand Human Karyotypes and can interpret various inheritance pattern using pedigree.

CO2: understand cells and molecules of immune system

CO3: understand the properties and types of cancer cell and interpret the role of gene mutation in cancer and cancer stem cells in progression

CO4: appraise the concept of Prenatal diagnosis and interpret the importance of Stem cells.

Content	56 hrs
Unit - I	14 hrs
Study of Human chromosomes and its inheritance pattern: Human Chromosomes: Normal Human Karyotype-GTG banding: Paris Nomenclature, Flow karyotyping, Fluorescence Activated Cell Sorter (FACS). Karyotype and clinical features of Cri-du chat, Down's and Turner's Syndrome. Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (Adult polycystic kidney and Neurofibromatosis), Recessive (Albinism, Sickle cell anaemia), X-linked – Recessive: (Duchenne muscular dystrophy-DMD), X-linked- Dominant: (Hypophosphatemia), Y-linked inheritance: Holandric gene, Multifactorial inheritance: (Rheumatoid arthritis and Diabetes), Mitochondrial diseases: (Leber's hereditary optic neuropathy).	

Unit - II	14 hrs
Immunogenetics: Introduction to immunology- Immunity- Innate and acquired, Cells and organs of immune system, Types and properties of antigens, and antibodies. Immune response - Humoral and Cell mediated Genetics of immune system – Inherited immunodeficiency- X- linked agammaglobulinaemia. Major Histocompatibility Complex- Classes, Transplantation, graft-rejection and immunosuppressors.	
Unit - III	14 hrs
Oncogenetics: A brief account of cancer: Definition, Benign and Malignant Tumours, Types of Cancer- Sarcoma, Carcinoma, Lymphoma and Leukaemia. Properties of malignant cells, Cancer stem cells. Chromosomal abnormalities associated with the specific malignancies- Acute Promyelocytic Leukaemia (APL), Chronic Myeloid Leukaemia (CML) and Acute lymphoblastic leukaemia (ALL). Genes of Oncogenesis: Oncogenes-c-ras and c-myc, V-onc and C – onc oncogenes, Tumor Suppressor genes-p53, pRb.	
Unit - IV	14 hrs
Prenatal diagnosis and Stem cells: Indications for prenatal diagnosis; Methods: Non-invasive method- Ultrasonography and Fetal echocardiography, Invasive methods - Amniocentesis, Chorionic villus sampling; pre-conceptional and pre-implantation genetic diagnosis- Teratogen exposure in early pregnancy. Genetic Counselling: Introduction, Historical overview, Counsellor and consultand, Stage of counselling 1: History and pedigree construction, Stage 2: Examination, Stage 3: Diagnosis, Stage 4: Counselling, Stage 5: Follow up. Stem cells - Properties, types and sources. A brief account on Cord blood banking.	

References:

1. Manage, E. J., & Manage, A. P. (1997). Basic human genetics (India reprint). Rastogi Publications.
2. Turnpenny, P. D., & Ellard, S. (2017). Emery's Elements of Medical Genetics and Genomics (15th ed.). Elsevier.
3. Bhatnagar, S. M., et al. (1999). Essentials of human genetics (4th ed.). Orient Longman.
4. King, R. A., et al. (2002). Genetic basis of common diseases. Oxford University Press.
5. Thompson, M. W., McInnes, R. R., & Willard, H. F. (1996). Genetics in Medicine (5th ed.). W. B. Saunders.
6. Rooney, D. E. (2001). Human Cytogenetics. Oxford University Press.
7. Korf, B. R. (2000). Human genetics. Blackwell Science.
8. Lewis, R. (2001). Human genetics: Concepts and applications. McGraw-Hill.
9. Gangane, S. D. (2001). Human genetics (2nd ed., reprint). Churchill Livingstone.

V SEMESTER B.SC., GENETICS THEORY SYLLABUS

PAPER VI: POPULATION AND EVOLUTIONARY GENETICS

Course Description

Program Name:	B.Sc., Genetics	Semester:	V
Course Title:	Population and Evolutionary Genetics (Theory)		
Course Code:	DSCGT6	No. of Credits:	3
Contact hours:	56 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	4 hrs
Formative Assessment Marks:	20	Summative Assessment Marks:	80

Course Out comes (COs): After the successful completion of the course, the student will be able to:

CO1: understand the role of evolutionary agents on Hardy-Weinberg equilibrium

CO2: describe the reproductive isolating mechanisms and speciation

CO3: appraise the implication of mutation in molecular evolution

CO4: understand the basic theories of Origin Of life and evolution.

Content	
	56 hrs
Unit - I	
Evolutionary Genetics and Mendelian Population: Theories of Evolution: Lamarckism, Darwinism, Neo-Darwinism, Modern/Synthetic Theory. Mendelian Population & Gene Pool: Gene and genotype frequency, Hardy-Weinberg principle and applications, Extension of HW- Multiple allele and sex linked. Sources of changes in allelic frequency: Effective population size, Genetic drift: Bottleneck effect & Founder principle. Migration and gene flow, Mutation.	14 hrs
Unit - II	
Selection and Speciation: Selection: Darwinian fitness and selection coefficient; Natural Selection and Types of selection- Stabilizing selection; Clutch size in <i>Ficedula albicollis</i> (Collared flycatcher), Directional selection; Industrial melanism in <i>Biston betularia</i> (Peppered moth), Disruptive selection; Polymorphism in <i>Cepaea nemoralis</i> (Land snail), Balanced Polymorphism; Heterozygote advantage (e.g., Sickle cell anemia and malaria resistance in African populations).	14 hrs

Unit - III	
Isolating mechanisms and Speciation: Reproductive Isolation: Pre-mating isolation: Geographic, climatic, seasonal, habitat, temporal, and ethological isolation; post-mating isolation: Gametic mortality, zygotic mortality, hybrid inviability, hybrid sterility, and hybrid breakdown. Speciation: Definition; Types: Sympatric, allopatric, parapatric and peripatric speciation. Co-evolution and convergent evolution.	14 hrs
Unit - IV	
Phylogenetics: Fundamentals of Phylogenetics: Types of phylogenetic trees: Rooted, unrooted, cladogram, and molecular evolution and molecular clock phylogram; Methods of phylogenetic tree construction and its applications.	14 hrs

References:

- Snustad, D. P., & Simmons, M. J. (2003). Principles of Genetics (3rd ed.). John Wiley & Sons.
- Snustad, D. P., & Simmons, M. J. (2019). Principles of Genetics (7th ed.). Wiley.
- Pierce, B. A. (2017). Genetics: A Conceptual Approach (6th ed.). W. H. Freeman.
- Atherly, A. G., Girton, J. R., & McDonald, J. F. (1999). The Science of Genetics. Saunders College Publishing.
- Hails, R. S. (2003). Genes in the Environment. Wiley-Blackwell.
- Hartl, D. L. (1988). A Primer of Population Genetics. Sinauer Associates.
- Li, W.-H., & Graur, D. (1991). Fundamentals of Molecular Evolution. Sinauer Associates.
- Price, P. W. (1996). Biological Evolution. Saunders College Publishing.
- Russo, V. E. A., Brody, S., Cove, D., & Ottolenghi, S. (1992). Development: The Molecular Genetic Approach. Springer-Verlag.
- Strickberger, M. W. (1996a). Evolution (2nd ed.). Jones & Bartlett.
- Strickberger, M. W. (1996b). Genetics (3rd ed.). Prentice Hall of India.
- Tamarin, R. H. (2000). Principles of Genetics (6th ed.). W. C. Brown Publishers.
- Wolpert, L., et al. (2002). Principles of Development (2nd ed.). Oxford University Press.

V SEMESTER B.Sc., GENETICS PRACTICAL SYLLABUS

PRACTICAL PAPER V: HUMAN GENETICS & POPULATION AND EVOLUTIONARY GENETICS

Program Name:	B.Sc., Genetics	Semester:	V
Course Title:	Human Genetics & Population and Evolutionary Genetics (Particle)		
Course Code:	DSCGP5	No. of Credits:	2
Contact hours:	45 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	3 hrs
Formative Assessment Marks:	10	Summative Assessment Marks:	40

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

CO1: Perform hematological and cytogenetic techniques, including blood cell counting and analysis of normal and abnormal karyotypes such as Down syndrome, Turner syndrome, and Klinefelter syndrome.

CO2: Construct and interpret pedigrees to determine inheritance patterns and genetic risk.

CO3: Apply immunological assays (ODD, RID, Dot ELISA) and identify cytomorphological features of cancers.

CO4: Analyze evolutionary mechanisms and solve population genetics problems involving gene and genotype frequencies.

Sl. No.	Practical Content	15 Units
1	Study of drum sticks in Neutrophils of Blood smear	2
2	Blood Cell counting using Haemocytometer (RBC and WBC)	2
3	Study of Karyotypes I: Normal Karyotyping in Human Study of Karyotypes II: Abnormal Karyotypes - Down's syndrome, Turner's syndrome and Klinefelter's syndrome	2
4	Karyotype: Preparation of Normal and abnormal Karyotype	1
5	Pedigree analysis and construction	1
6	Performance of Ouchterlony Double Diffusion (ODD) , Radial Immuno Diffusion (RID) and Dot ELISA.	2
7	Study of cytomorphological features of uterine and prostate cancers (Permanent slides or photographs).	1

8	Experiments on natural selection, male selection, female selection, genetic drift- Population size, sampling error.	2
9	Study of population genetics problems- Population Genetics, Gene and Genotype Frequencies. (Min 3 problems in each)	2

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment, Test

Formative Assessment for Theory	
Assessment Occasion/type	Marks
CI: House Examination/Test	10
C2: Written Assessment/Presentation/Project/Term Papers/Seminars	05
Attendance	05
Total	20

Formative Assessment for Practical	
Assessment Occasion/type	Marks
House Examination/Test	05
Class Room Performance / Attendance	05
Total	10

References:

1. Humason, G. L. (1979). *Animal tissue techniques* (4th ed.). W. H. Freeman.
2. Freshney, R. I. (2016). *Culture of animal cells: A manual of basic technique and specialized applications* (7th ed.). Wiley-Blackwell.
3. Sambrook, J., & Russell, D. W. (2001). *Molecular cloning: A laboratory manual* (3rd ed.). Cold Spring Harbor Laboratory Press.
4. Gurtler, H., & Stetter, K. O. (Eds.). (2008). *Practical methods in molecular biology*. Springer.
5. Coligan, J. E., et al. (2005). *Current protocols in immunology*. John Wiley & Sons.

Scheme of Practical Examination

IV Semester BSc., Genetics Subject: HUMAN GENETICS (DSCGP-5)

Duration: 3 hours

Max. Marks: 40

1	Prepare blood smear to demonstrate drums stick in neutrophil and comment on the result. (Preparations – 06 marks, Result-02, Comment -02) 10 marks OR Prepare a karyotype from the given metaphase spread (normal / abnormal) and comment and the result. (Preparations – 08 marks, Comment -02)	10 marks
2	Count RBC/WBC using Haemocytometer. Calculate the cell count and comment on the result. (Performance: 6 M, Calculation – 2 M, and comment – 2m).	10 marks
3	Problem on Pedigree	04 marks
4	Solve the Genetic problem on Population Genetics: Gene and Genotype Frequencies.	03 marks
5	Identify and comment on the given Karyotype. Normal /Abnormal karyotype.	03 marks
6	Identify and comment on B and C B - RID / ODD, Uterine/ Prostrate cancer C - Genetic drift, natural selection.	2.5 X 2 = 5 marks
5	Class Record.	05 marks
	Total	40 marks

V SEMESTER B.Sc., GENETICS SKILL ENHANCEMENT PROGRAM**DSGS2: MOLECULAR TOOLS IN GENETICS**Course Description

Program Name:	B.Sc., Genetics	Semester:	V
Course Title:	Molecular Tools in Genetics		
Course Code:	DSGS2	No. of Credits:	2
Contact hours:	45 Hours	Duration of SEA/Exam:	2 hrs
		Hours / Week:	2 hrs
Formative Assessment Marks:	10	Summative Assessment Marks:	40

Course Out comes (COs): After the successful completion of the course, the student will be able to:

CO1: Understand molecular tools in analysing Human Diseases.

CO2: Apply molecular markers in sequence analysis.

CO3: Assess DNA quality and quantity.

CO4: Apply bioinformatics tools in sequence analysis.

Sl. No.	Practical Content	15 Units
1.	Introduction to Molecular tools in Genetics: Overview of evolutionary genetics and its applications.	1
2.	Introduction to molecular markers: SNPs, microsatellites, mtDNA, and whole-genome sequencing.	2
3.	DNA Extraction and Purification from Various Samples: Assessing DNA quality and quantity using spectrophotometry and gel electrophoresis.	5
4.	Polymerase Chain Reaction (PCR) and Gel Electrophoresis: Running and analysing PCR products using agarose gel electrophoresis	4
5.	Analysing sequence chromatograms using bioinformatics tools.	1
6.	Phylogenetic Tree Construction Using Molecular Data: Aligning DNA sequences using ClustalW or MUSCLE	2

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative

Assessment Tests:

Formative Assessment for Theory	
Assessment Occasion/type	Marks
CI: House Examination/Test	10
C2: Written Assessment/Presentation/Project/Term Papers/Seminars	05
Attendance	05
Total	20

Scheme of Particle Examination**VI- DSGS2: MOLECULAR TOOLS IN GENETICS****Scheme of Valuation**

1. DNA Extraction from the given sample (Extraction – 07 marks, Protocol-03, Principle -02)	12 marks
2. Analysis of PCR product using agarose gel. (Analysis -5, Principle -04)	09 marks
3. Spotters: (Identification – 1, Comments– 2 for each).	2x3M = 6 marks
4. Methodology – 4 Marks for each.	8 marks
5. Class Records.	5 marks

References:

- Kumar, V., Abbas, A. K., & Aster, J. C. (2020). Robbins and Cotran Pathologic Basis of Disease (10th ed.). Elsevier.
- Coleman, W. B., & Tsongalis, G. J. (2017). Molecular Pathology: The Molecular Basis of Human Disease (2nd ed.). Academic Press.
- Pecorino, L. (2021). Molecular Biology of Cancer (5th ed.). Oxford University Press.
- Nature Reviews Molecular Cell Biology. (n.d.). Nature Publishing Group. The Lancet. (n.d.). Elsevier.
- The New England Journal of Medicine. (n.d.). Massachusetts Medical Society.

VI SEMESTER B.SC., GENETICS THEORY SYLLABUS

PAPER VII: GENETIC ENGINEERING

Course Description

Program Name:	B.Sc., Genetics	Semester:	VI
Course Title:	Genetic Engineering (Theory)		
Course Code:	DSCGT7	No. of Credits:	3
Contact hours:	56 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	4 hrs
Formative Assessment Marks:	20	Summative Assessment Marks:	80

- **Course Out comes (COs):** After the successful completion of the course, the student will be able to:
- **CO1:** understand and apply the Molecular tools in genetic engineering.
- **CO2:** understand Recombinant DNA (rDNA) Construction and Gene Cloning Techniques.
- **CO3:** understand Advanced Genetic Engineering and Genomics.
- **CO4:** understand the Future Perspectives and Industrial Applications of Genetic Engineering.

Contents	56 hrs
Unit - I	14 hrs
Fundamentals of Genetic Engineering: Introduction to Genetic Engineering, scope and applications. Tools of Genetic Engineering: Enzymes: Restriction endonucleases (types and nomenclature), ligases, polymerases, phosphatases. Vectors: Plasmids (pUC18, pBR322), bacteriophage vectors (Lambda, M13), cosmids, shuttle vectors, expression vectors (BAC, YAC). Techniques in Genetic Engineering: PCR, Gel Electrophoresis (AGE, PAGE), Southern, Northern, and Western Blotting.	
Unit - II	14 hrs
Recombinant DNA Technology: Recombinant DNA (rDNA) Construction - Isolation of genomic and plasmid DNA, cDNA synthesis (Reverse Transcription), restriction digestion, ligation. Gene Cloning Techniques: Transformation (Calcium chloride, electroporation); Transfection methods in plants (Agrobacterium-mediated, gene gun) and animals (microinjection, liposome fusion). Screening and Selection of Recombinants - Blue-white screening, colony hybridization, PCR-based screening.	
Unit - III	14 hrs
Advanced Genetic Engineering and Genomics: Genome Mapping and Gene Libraries: Construction of genomic and cDNA libraries. DNA Sequencing Methods - Sanger's dideoxy method; Next-generation	

sequencing (NGS). Applications in Medicine: Gene therapy (ADA, SCID), recombinant vaccines (hepatitis, COVID-19). Applications in Agriculture: GMO crops (Bt cotton, golden rice), gene silencing (RNAi).	
Unit - IV	14 hrs
Future Perspectives and Industrial Applications: Industrial Biotechnology Applications - Biopharmaceuticals (Recombinant insulin, Growth hormone), Industrial enzyme production (Taq polymerase, cellulases). Environmental Applications: Bioremediation, Genetically Engineered Microorganisms (GEMs), Xenobiotics. Recent Trends and Future Directions: Personalized medicine, regenerative medicine, bioinformatics in genetic engineering.	

References:

1. Biotechnology, Satyanarayana U (2010) Books and allied (P) Ltd., Kolkata.
2. Essentials of plant Breeding, Phundan Singh, Kalyanai publishers, 2015.
3. Gene cloning and DNA analysis, T.A. Brown (2010) 6th edition, Wiley-Blackwell publication.
4. Human Molecular Genetics, Peter Sudbery (2002) 2nd Edition, Prentice Hall.
5. Human Molecular Genetics, Tom Strachen and Andrew P. Read (1999) 2nd edition, John Wile and sons.
6. Molecular Biotechnology, Principals and application of recombinant DNA Glick and Pasternak. 2010.
7. Gene Cloning and Manipulation, Christopher Hawe (2007), 2nd edition., Cambridge University press.
8. Principles of gene manipulation, Old R.W. and S.B. Primrose (1994) Boston Blackwell Scientific Publication.
9. <https://www.sciencedirect.com>.
10. <https://www.news-medical.net/health/Genetic-Testing-for-Diabetes.aspx>.

Note: Submission of practical record is mandatory as a part of practical examination.

VI SEMESTER B.SC., GENETICS THEORY SYLLABUS

PAPER VIII: APPLIED GENETICS

Course Description

Program Name:	B.Sc., Genetics	Semester:	VI
Course Title:	Applied Genetics (Theory)		
Course Code:	DSCGT8	No. of Credits:	3
Contact hours:	56 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	4 hrs
Formative Assessment Marks:	20	Summative Assessment Marks:	80

Course Out comes (COs): After the successful completion of the course, the student will be able to:

- CO1:** Apply genetic techniques in forensic science, paternity testing, and clinical diagnostics for personalized healthcare.
- CO2:** Utilize bioinformatics tools to analyze genomic data and understand applications in personalized medicine and evolutionary studies
- CO3:** Evaluate the role of recombinant DNA technology, CRISPR-Cas gene editing, and transgenic organisms in research and industry
- CO4:** Assess the role of applied genetics in medical diagnostics, gene therapy, plant and animal breeding. Evaluate the applications of nano biosensors in disease diagnosis.

Contents	56 hrs
Unit - I	14 hrs
Gene editing: CRISPR-Cas9 and gene editing techniques, Applications; Gene therapy- Somatic and Germ cell gene therapy; <i>in vivo</i> & <i>ex vivo</i> genetherapy, Gene therapy for cancer. Stem cells therapy – Bone marrow, Cornea, IPSc (Induced pluripotent stem cells). Applications of stem cells. Regeneration Therapy.	
Unit – II	14 hrs
Nanotechnology in Genetics- Introduction, Nanoparticles- Gold, silver, liposomes, dendrimers, polymeric nanoparticles, Nano-Biosensors, quantum dots and their uses. Role of nanotechnology in drug delivery.	
Unit - III	14 hrs
Transgenic animals – methods for producing transgenic animals, examples of transgenic animals – Mice, Super fish, Glo fish, Enviro pig, ANDi; Transgenesis in the improvement of production traits - growth and meat traits, wool production, milk composition.	

Transgenic Plants: Genetically modified crops for insect resistance - Bt crops. Genetically modified crops for Virus resistance - antisense and sense mediated resistance, Transgenic plants for product quality – improved storage, longer shelf life, nutritional quality (Golden Rice).	
Unit - IV	14 hrs
Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope, Applications and Research areas of Bioinformatics. Biological Databases: Significance, Primary and Secondary databases, Flat file formats, Nucleotide and proteome databases. Sequence Analysis: Nucleotide and proteomic sequence analysis, Homology sequence analysis – BLAST, FASTA, Pairwise sequence analysis, Dot plots, Multiple sequences- CLUSTALW, Phylogenetic analysis. Single Nucleotide Polymorphisms, Mapping disease-associated SNPs: Alzheimer's disease.	

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. Sty and D. Valle (EdsOMcGrawHill, New York.

PRACTICAL PAPER VI: GENETIC ENGINEERING & APPLIED GENETICS

Program Name:	B.Sc., Genetics	Semester:	VI
Course Title:	Genetic Engineering & Applied Genetics (Particle)		
Course Code:	DSCGP6	No. of Credits:	2
Contact hours:	45 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	3 hrs
Formative Assessment Marks:	10	Summative Assessment Marks:	40

Course Outcomes (COs):

At the end of the course the student should be able to:

CO1. Understand the nucleic acid isolation.

CO2. Develop skills for performing the Nucleic acid separation and Bioinformatics

CO3. Learn the technique of cloning such as restriction digestion and transformation

CO4. Study the technique of amplification of DNA and blotting method.

Sl. No.	Practical Content	15 Units
1.	Isolation of Genomic DNA from plant material	2
2.	Isolation of Plasmid DNA from bacteria	2
3.	Separation of DNA by AGE	2
4.	Quantification of DNA by Burtons/DPA method	2
5.	Analysis of DNA or Protein sequence using Bioinformatics tools	
6.	Demonstration experiments a. Transformation in bacteria b. Southern blotting c. Western blotting b. 4.RFLP c. 5.PCR	4
7.	Study on: a. 1.YAC b. 2.Micro injection c. 3.Immunological screening 5. Transgenic animals 6. Transgenic plants d. Phylogenetic tree construction	3

References:

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

Scheme of Practical Examination

VI - Semester

Paper –DSCGP6: Genetic Engineering & Applied Genetics

Duration: 03 hrs

Max Marks: 40

Scheme of Valuation

1. Isolate genomic DNA from the given sample (Extraction – 07 marks, Protocol-03, Principle -02).	12 marks
2. Quantify DNA from the given sample and comment on the principle involved (Principle - 2, Performance and Observation table – 4, Standard graph and result- 3).	09 marks
OR	
Analyse the DNA or Protein sequence using Bioinformatics tools (Sequence Retrieval- 3 Preprocessing-3 Alignment & Identification-3).	
3. Spotters: (Identification – 1, Comments– 2 for each).	2 x 3M = 6 marks
4. Methodology – 4 Marks for each	2 x 4M = 8 marks
5. Class Records	5 marks

VI SEMESTER B.SC., GENETICS
DSGS-3: PROJECT/ INTERNSHIP

Course Description

Program Name:	B.Sc., Genetics	Semester:	VI
Course Title:	Project/ Internship		
Course Code:	DSGS3	No. of Credits:	2
Contact hours:	45 Hours	Duration of SEA/Exam:	2 hrs
		Hours / Week:	2 hrs
Formative Assessment Marks:	10	Summative Assessment Marks:	40

1. Introduction

The Internship Programme is a mandatory component of the Undergraduate (UG) curriculum. It is designed to provide students with practical exposure to real-world work environments, enabling them to apply theoretical knowledge, develop professional skills, and gain industry or field experience relevant to their discipline.

2. Duration of Internship

The internship shall be undertaken during the **VI Semester** of the programme as prescribed in the curriculum.

The duration of the internship shall be **4 to 6 weeks / 90 hours** as prescribed by the University.

Students may complete the internship in industries, research laboratories, hospitals, NGOs, government organizations, educational institutions, or other relevant organizations related to their subject.

3. Approval of Internship

The internship organization must be approved by the Head of the Department (HoD) or Internship Coordinator.

Students must submit an internship proposal or consent letter from the organization before commencing the internship.

4. Attendance and Conduct

Students must maintain at least 90% attendance during the internship period. They must follow the rules, discipline, and work ethics of the host organization. Any misconduct or absence without permission may lead to cancellation of the internship.

5. Internship Report Submission

At the end of the internship, students must submit a detailed Internship Report certified by the Supervisor, Authority of the Host Organization and HoD / HoI.

The report should include:

- a. Introduction of the organization
- b. Objectives of the internship
- c. Work carried out / training received
- d. Skills learned and observations
- e. Conclusion and learning outcomes

6. Evaluation of Internship (Total: 50 Marks)

Sl. No.	Component	Marks
1	Attendance and Performance at Organization (Certified by Supervisor)	10
2	Internship Report / Record	30
3	Presentation / Viva-Voce	10
	Total	50 Marks

7. Viva-Voce Examination

Students must give a presentation or appear for a viva-voce before the departmental committee.

The committee may consist of HoD, Internship Coordinator and subject faculty members.

8. Certification

Students must submit the Internship Completion Certificate issued by the host organization along with the report.

9. Passing Criteria

Students must obtain a minimum of 40% marks in the internship evaluation to pass.

Students who fail to complete the internship or submit the report must repeat the internship as per departmental guidelines.

MODEL QUESTION PAPER FOR ELECTIVE

Duration: 2 hrs

Maximum Marks: 40

Instructions to Candidates:

1. All sections/parts are compulsory.
2. Draw neat labelled diagrams wherever necessary.

PART- A

I. Answer any **FIVE** of the following:

(5x2=10)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

PART- B

II. Answer any **FOUR** of the following:

(4x5=20)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

PART- C

III. Answer any **ONE** of the following:

(1x10=10)

- 1.
- 2.
- 3.
