TEACHING PLAN: Genetics and Immunology

SCHOOL: SCHOOL OF BASIC & APPLIED SCIENCES (SOBAS), RAFFLES UNIVERSITY		
ACADEMIC SESSION: 2022 – 2025		FOR STUDENT'S BATCH: B.Sc. (CBZ) II Year (IV- Semester)
1	**Course No.**	ZOO – 202
2	**Course Title**	Genetics and Immunology
	Credits	**3**
4	**Learning Hours**	**Contact Hours: 36** **Assessment: 22** **Guided Study: 32** **Total hours: 90** **3 lectures per week**

5	**Course Objective**	1. Understand the fundamental principles of heredity, including extensions and modifications. 2. Comprehend the chromosomal theory of inheritance and its significance in genetic transmission. 3. Analyze linkage and recombination, exploring coupling and repulsion hypotheses, crossing over, and chiasma formation. 4. Investigate multiple alleles and gene interactions, both allelic and non-allelic. 5. Explore variation types and sources, and delve into mutations, including chromosome and gene mutations, and their implications. 6. Examine sex-linked inheritance, studying chromosomal sex determination and specific cases like haemophilia and color blindness. 7. Gain insights into human genetics, covering karyotypes, genetic counseling, chromosomal abnormalities, and inborn errors of metabolism. 8. Explore applied genetics, including genetic engineering, transgenic animals, eugenics, and ethical considerations. 9. Develop a foundational understanding of immunology, encompassing innate and acquired immunity, antigens, antibodies, humoral and cell-mediated immunity. 10. Explore active and passive immunization, blood groups and transfusions, tissue and organ transplants, allergies, autoimmune diseases, and immunodeficiency diseases.
6	**Course Outcomes**	1. Understand and apply the basic principles of heredity, showcasing a comprehensive grasp of genetic concepts and their extensions. 2. Apply the chromosomal theory of inheritance to analyze and interpret genetic transmission patterns in various organisms. 3. Evaluate and interpret genetic linkage and recombination phenomena, demonstrating an understanding of coupling and repulsion hypotheses, crossing over, and chiasma formation.

		4. Analyze and interpret various types and sources of genetic variation, including mutations, and understand their implications in genetic diversity. 5. Critically analyze and interpret cases of sex-linked inheritance, including the chromosomal system of sex determination and specific examples such as haemophilia and color blindness. 6. Apply knowledge of human genetics to analyze karyotypes, understand genetic counseling and chromosomal abnormalities, and evaluate inborn errors of metabolism. 7. Critically assess the implications of genetic engineering, transgenic animals, and ethical considerations in the field of applied genetics. 8. Apply the principles of immunology to understand innate and acquired immunity, antigen-antibody interactions, and the mechanisms of humoral and cell-mediated immunity. 9. Analyze and compare active and passive immunization strategies, blood groups and transfusions, tissue and organ transplants, and their relevance in healthcare. 10. Evaluate the broader societal impact of genetic advancements and immunological knowledge, considering ethical implications and potential applications in healthcare and biotechnology.

7.	Outline syllabus:				
7.01	Paper Code	Unit	Introduction	Reference number	Teaching methods
	Paper Code: ZOO-202	I	1. Basic principles of Heredity, basic idea on extensions and modifications of basic principles 2. Chromosomal theory of Inheritance. 3. Linkage and recombination : coupling and repulsion hypothesis, crossing over and chiasma formation 4. 4. Multiple alleles, gene interactions (allelic and non-allelic)		Providing them notes, elucidating all processes and mechanisms on a whiteboard, and conveying information through presentations (PPT) and videos.
		II	1. Variation; types, sources of variation. 2. Mutation; chromosome and gene mutations, implications of mutation 3. Sex linked Inheritance: Chromosomal system of sex determination, Haemophilia and 5. Colour blindness in man, Eye colour in Drosophila, Non-disjunction of sex chromosomes 6. in Drosophila		--------do-------

		III	1. Human genetics: Human Karyotype, genetic counselling and testing, Chromosomal abnormalities involving autosomes and sex chromosomes, monozygotic and dizygotic twins, Inborn errors of metabolism (Alcaptonuria, Phenylketonuria, Albinism, Sickle-cell anaemia), DNA fingerprinting, genetic compatibility 2. Applied genetics; genetic engineering, implications, transgenic animals, eugenics, euthenics and euphenics.		--------do-------
		IV	Immunology - Innate and Acquired immunity, Antigen, Antibody, Humoral and cell mediated immunity, Active and passive immunization, Blood groups and transfusions, tissue and organ transplants, Allergies, autoimmune diseases, immunodeficiency diseases.		--------do-------

8.	Course Evaluation	
8.1	CA: 20%	
8.2	Attendance	5
8.3	Homework	-
8.4	Quizzes	5
8.5	Projects	-
8.6	Presentation	10
8.7	Any other	-
8.2	MTE	20%
8.3	End-term examination	60%
9.	Textbooks & References	
9.1	Textbook	-
9.2	References	Klug, W. S., & Cummings, M. R. (2003). Concepts of genetics (No. Ed. 7). Pearson Education, Inc. Vega, L. (2019). Fundamentals of genetics. Scientific e-Resources. Russell, P. J., & Gordey, K. (2002). IGenetics (No. QH430 R87). San Francisco: Benjamin Cummings. Verma, P. S., & Agarwal, V. K. (2009). Genetics, (Multicolour Edition). S. Chand Publishing.
9.3	Video References	https://www.youtube.com/live/VTlHmklg_f4?si=hbMwqGpBqMPBdNns https://youtu.be/jLeAOWLC9eo?si=ucPKnXUPgZj2_VED https://youtu.be/6rYQmU-5rOQ?si=fREOM4AANM79BTn0

Practical's: Zoology Lab – IV (6 labs per week)

Outcome	Unit I	Unit II	Unit III	Unit IV
1	✔			
2	✔			
3	✔			
4	✔	✔		
5		✔		
6		✔	✔	
7		✔	✔	
8			✔	✔
9			✔	✔
10			✔	✔

Question Bank

1. What are the basic principles of heredity, and how are they extended or modified?
2. Explain the chromosomal theory of inheritance and its application in analyzing genetic transmission patterns.
3. What are the coupling and repulsion hypotheses in genetic linkage, and how do they relate to crossing over and chiasma formation?
4. Describe the different types and sources of genetic variation, including mutations, and discuss their implications in genetic diversity.
5. Critically analyze and interpret a case of sex-linked inheritance, considering the chromosomal system of sex determination.
6. How can knowledge of human genetics be applied to analyze karyotypes and understand genetic counseling and chromosomal abnormalities?
7. Assess the implications of genetic engineering, transgenic animals, and ethical considerations in the field of applied genetics.
8. Explain the principles of immunology, differentiating between innate and acquired immunity.
9. Discuss antigen-antibody interactions and the mechanisms of humoral and cell-mediated immunity.
10. Compare and contrast active and passive immunization strategies.
11. Explain the relevance of blood groups and transfusions in healthcare.
12. Describe the processes involved in tissue and organ transplants and their significance.
13. Discuss the broader societal impact of genetic advancements, considering ethical implications and potential applications in healthcare and biotechnology.
14. What are the basic ideas behind the extensions and modifications of the basic principles of heredity?
15. Elaborate on the chromosomal theory of inheritance and its significance in analyzing genetic transmission patterns.
16. Explain the coupling and repulsion hypotheses in genetic linkage and their relation to crossing over and chiasma formation.

17. Discuss the different types and sources of genetic variation, focusing on mutations and their implications.
18. Analyze a case of sex-linked inheritance, considering the chromosomal system of sex determination.
19. Apply knowledge of human genetics to analyze karyotypes and understand genetic counseling and chromosomal abnormalities.
20. Evaluate the implications of genetic engineering and transgenic animals in the field of applied genetics.
21. Differentiate between innate and acquired immunity, discussing antigen-antibody interactions.
22. Explain the mechanisms of humoral and cell-mediated immunity.
23. Compare active and passive immunization strategies, emphasizing their differences.
24. Discuss the relevance of blood groups and transfusions in healthcare.
25. Evaluate the societal impact of genetic advancements, considering ethical implications and applications in healthcare and biotechnology.

PROJECTS (To be given to group of students)

Project 1: Genetic Trait Investigation
Objective: Explore and present a comprehensive study on a specific genetic trait in humans or other organisms. Investigate its inheritance patterns, associated mutations, and implications for genetic diversity.

Project 2: Genetic Engineering and Ethical Dilemmas
Objective: Analyze the ethical considerations surrounding genetic engineering. Research and present a project that explores the ethical implications of genetic modifications, transgenic animals, and the societal impact of these advancements.

Project 3: Immunological Case Study
Objective: Conduct a case study on a specific immunological disorder, autoimmune disease, or immunodeficiency disease. Present findings on the causes, symptoms, and potential treatments, emphasizing the relevance to healthcare.

Project 4: Human Genetic Counseling Simulation
Objective: Create a simulated scenario for genetic counseling, incorporating information on human karyotypes, chromosomal abnormalities, and inborn errors of metabolism. Develop counseling strategies and recommendations for prospective parents.

Project 5: Biotechnological Applications in Medicine
Objective: Explore the applications of biotechnology in healthcare. Investigate recent advancements such as gene therapies, CRISPR technology, and personalized medicine. Present the potential benefits and ethical considerations associated with these applications.