B Sc (Biomedical Science)

Under Regulations- (R-2022)

(w.e.f. 2022-23 admitted batch)

Course Structure and Syllabi

THE APOLLO UNIVERSITY

MURUKAMBATTU - CHITTOOR (Dt) 517127

ANDHRA PRADESH

PROGRAM OUTCOMES (PO)

PO 1: Demonstrate understanding of human anatomy and physiology: Students will exhibit comprehensive knowledge of human anatomy and physiology, including organ systems, cellular functions, and physiological processes.

PO 2: Apply principles of biochemistry and molecular biology: Students will apply principles of biochemistry and molecular biology to understand cellular metabolism, genetic regulation, and biochemical pathways relevant to human health and disease.

PO 3: Utilize laboratory techniques: Students will proficiently use laboratory techniques and instrumentation common in biomedical research and clinical diagnostics, including microscopy, immunoassays, and molecular biology techniques.

PO 4: Analyze biomedical data: Students will critically analyze biomedical data using statistical methods and bioinformatics tools to draw valid conclusions and propose hypotheses.

PO 5: Understand disease mechanisms: Students will comprehend the molecular, cellular, and physiological mechanisms underlying human diseases, including genetic disorders, infectious diseases, and chronic conditions.

PO 6: Integrate knowledge across disciplines: Students will integrate knowledge from diverse disciplines such as biology, chemistry, pharmacology, and pathology to understand complex biomedical issues.

PO 7: Evaluate biomedical literature: Students will critically evaluate scientific literature in biomedical sciences, assess experimental methodologies, interpret data, and evaluate the impact of research findings.

PO 8: Communicate effectively: Students will effectively communicate biomedical concepts, experimental findings, and scientific conclusions through written reports, oral presentations, and scientific posters.

PO 9: Apply ethical principles: Students will apply ethical principles in biomedical research and clinical practice, demonstrating awareness of ethical issues related to human subjects, animal research, and biotechnological advancements.

PO 10: Collaborate in interdisciplinary teams: Students will collaborate effectively in interdisciplinary teams to solve biomedical research problems and develop innovative solutions for improving human health.

PO 11: Understand healthcare systems: Students will understand the organization, structure, and policies of healthcare systems, including healthcare delivery, public health initiatives, and regulatory frameworks.

PO 12: Prepare for professional careers: Students will be prepared for diverse careers in biomedical research, healthcare professions, biotechnology industries, and regulatory agencies, demonstrating readiness for advanced study or employment in the field.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):

PEO 1: Graduates will be equipped with the knowledge, skills, and professional competencies necessary to pursue careers in healthcare professions, biomedical research, pharmaceutical industries, or regulatory agencies.

PEO 2: Graduates will develop critical thinking skills to analyze complex biomedical issues, apply scientific reasoning to solve problems, and contribute to advancements in understanding human health and disease.

PEO 3: Graduates will demonstrate ethical awareness and professionalism in biomedical research and clinical practice, adhering to ethical standards, respecting patient confidentiality, and contributing responsibly to the scientific community and society.

PROGRAM SPECIFIC OUTCOMES (PSO):

After successful completion of the program the graduates will be able to:

PSO1: Demonstrate proficiency in conducting and interpreting biomedical laboratory techniques, including histology, immunohistochemistry, flow cytometry, ELISA, and molecular biology techniques such as PCR, Western blotting, and DNA sequencing.

PSO 2: Analyze and interpret complex biomedical data using statistical methods and bioinformatics tools, drawing conclusions relevant to human health, disease mechanisms, and therapeutic interventions.

PSO 3: Integrate knowledge from diverse disciplines such as anatomy, physiology, biochemistry, pharmacology, and pathology to address biomedical research questions, contributing to advancements in medical science and healthcare practices.

THE APOLLO UNIVERSITY

ACADEMIC REGULATIONS

SCOPE:

This Academic regulation provide a framework for the regulatory guidelines of all programs offered by The Apollo University. It includes procedures and practices that are to be followed to ensure academic standards in the University. The regulations are approved by the Academic Council. These regulations may be amended from time to time with the approval of the Academic council for the benefit of students or some times to reflect the changes suggested by the statutory bodies.

Information regarding amendments (if any) to the regulations will be communicated to the students by publishing in the University website. Students must follow the amended regulations as they might impact the process for the award of degree. The decision of the Vice Chancellor shall be the final in case of any discrepancy. These regulations apply to all students, despite the program of study.

1. ADMISSION INTO THE PROGRAM

The University admits the students in two modes. One through the convenor quota as per the Andhra Pradesh Private Universities Act, for which the admissions will be carried out through the convener quota by the Govt of Andhra Pradesh. The other is through University quota for which the following procedure will be followed:

A. The applicant shall satisfy the entrance requirements specified by The Apollo University and in accordance with guidelines of statutory councils for Under-graduation.
B. The Applicant shall be qualified in the qualifying examination for a particular program.
C. The Applicant secures a rank in national level entrance exam or suitable such test conducted by The Apollo University / professional body.
D. The Applicant qualifies in the specified state or national level examinations prescribed by The Apollo University.

The Apollo University will widely notify the counselling schedule for admissions into the academic programs in the media. The provisional admission will be given to the eligible students during the counseling scheduled by The Apollo University. The selected candidates will be provisionally admitted into the program of his/her choice if the candidate meets the program specific requirements in addition to academic performance qualifying exam. Admission is purely based on merit and so merely meeting the requirements will not ensure

admission. The University does not discriminate based on gender, race, region, religion, disability or nationality. The University reserves the right to make admissions based on various criteria which is specified in the admission brochure.

2. ELIGIBILITY CRITERIA

Undergraduate programs

The qualifying exam eligibility for each program is given Annexure 1. The student should have passed the qualifying exam either in the year the student is seeking admission or the previous year.

Convener Quota: The student seeking admission to any program under convener quota shall qualify in the relevant entrance exam conducted by the Government of Andhra Pradesh.

University Quota: For getting admission under University quota, percentage of marks obtained in the qualifying exam, the rank obtained in TAU entrance exam or any recognized national level examination in the year of admission will be considered.

Counselling

All the eligible students need to apply for admission and have to attend counselling conducted by TAU as per the schedule for the university quo

3. PROGRAMS

The Apollo University offers variety of programs which includes certificate, undergraduate, postgraduate, and Research. The list of programs on offer for the academic year 2022-23 are annexed in Annexure 2 and those of 2023-24 are annexed in Annexure 3.

Minimum duration of the program

The minimum duration of each program depends on the type of program, viz., undergraduate, postgraduate, integrated programs, etc., and the faculty which offers the program. The maximum duration of the program is N+2 years, where N stands for the minimum duration of the program as mentioned in Annexure 2 and 3. If the student has not obtained the minimum number of credits within the stipulated time, the Vice-Chancellor may extend the maximum duration in extenuating circumstances upon receiving a request along with reasons from the student for not completing the program on time.

4. CHOICE BASED CREDIT SYSTEM

The choice-based credit system (CBCS) facilitates the education student-centric. It provides the opportunity for the learner to choose the courses from a basket of core, elective, and skill enhanced courses. All programs of study are designed to meet the specified number of credit requirements. The courses taken by the student in each semester as part of program are allotted some credit points based on the number of hours assigned. Upon successful completion of the course, the student secures the number of credits allotted for that course. Once the minimum number of credits of the program is achieved, the degree can be awarded, subject to fulfilment of all other relevant conditions.

5. STRUCTURE OF THE PROGRAM

The Program structure Consists of

i) University Courses
   A. University Core
   B. University Electives
ii) Faculty Courses
   A. Faculty Core
   B. Faculty Electives
iii) Program Courses
   A. Program Core
   B. Program electives

Each course* is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. (*one course means one subject)

Core Courses = 3 Credits /4 Credits Elective =3 Credits

In general, credits are assigned to the courses as detailed below:

- A classroom lecture/ tutorial of 60 min (1 hr) duration per week, spread over the entire semester, shall be considered as one credit.
- A laboratory session of minimum of 120 min (2 hr) per week shall be considered as one credit.
- A project work/ Internship session of 60 minutes (1 hr) carried out per week shall be considered as one credit.

6. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

7. REGISTRATION

Any of the following student must register for the courses opted in a particular semester during the scheduled registration period.

i. a new student who enrolls into any program
ii. an existing student who is continuing on rolls from the preceding regular semester
iii. a former student, i.e., who has not enrolled in the preceding regular semester or who has availed academic break or detained and got readmission

Each newly admitted student shall attend an induction/ orientation program prior to commencement of the first semester. During this program academic advisors assist the students in choosing the courses. Existing student may register online by using their registration number and mail ID through the Apollo ERP portal. Class schedules are available approximately two weeks before the beginning of every semester for each program. The concerned head of the department must approve class schedule.

8. ATTENDANCE REQUIREMENTS

- Students should earn a minimum of 80% attendance in the current semester to become eligible to write the Semester End Examinations.
- The monthly statement of attendance will be displayed on the Department Notice Board/ Apollo ERP by the respective departments within the first five working days of the following month.
- Candidates who are falling short of 80% attendance will be detained on the recommendation of the HoD and are not eligible to appear for the current semester examinations. The students who are detained in the current semester will not be allowed to register for the next semester and they have to repeat the same semester by paying the tuition fee prescribed. However, they can write arrear subjects, if any.

9. EVALUATION

The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks). A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination. Practical/ Project Work/ Industrial Training/ Viva voce/ Seminar etc. are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 50% to secure

Pass Grade. For courses having both theory and practical components, 60% of the weightage will be given for theory component and 40% weightage for practical component. The student must secure 40% (Theory + Practical) with 24 marks minimum in theory to attain pass grade.
Details of Assessment Procedure are furnished below in Table 1.

Table 1: Assessment Procedure

S. No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory	40	Continuous Evaluation	i) Twenty (20) marks for mid examinations. Three mid examinations shall be conducted for 20 marks each; average of the best two performances shall be taken into consideration. ii) Ten (10) marks for Quizzes, Assignments and Presentations. iii) Ten (10) marks for periodic evaluation, case studies and projects
		60	Semester-end Examination	iv) Sixty (60) marks for Semester-end examinations
	Total	**100**		
2	Laboratory	100	Continuous Evaluation	1)80 marks with equal weightage to all experiments subject to conduct of minimum of 10 experiments 2)20marks for the end exam (with one of our university teachers as external other than course teacher)
3	Internship	100	Continuous Evaluation	i) (80) marks for periodic evaluation of Internship report by the Project Supervisor. ii) Twenty (20) marks for final Report presentation and Viva-voce, by a panel of internal examiners.

				iii) Students shall undergo TWO internships during the course of time and the evaluation shall be done during final semester.
4	Project work	100	Continuous Evaluation	iv) (80) marks for periodic evaluation and technical report writing by the Project Supervisor. ii) Twenty (20) marks for final Report presentation and Viva-voce, by a panel of internal examiners
5	Students Seminars	100	Continuous Evaluation	Each student has to give a seminar on any topic in consultation with the faculty member in charge A detailed report shall be submitted to the in charge. 60 marks for periodic evaluation including report preparation and 40 marks for viva voce by a panel of examiners.

GRADING SYSTEM

Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given inTable2.

Table 2: Grades & Grade Points

Sl. No.	**Grade**	**Grade Points**	**Absolute Marks**
1	O(Outstanding)	10	90 and above
2	A+(Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+(Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C(Average)	5	45 to 49
7	P(Pass)	4	40 to 44
8	F(Fail)	0	Less than 40
9	Ab. (Absent)	0	-

SEMESTER GRADEPOINTAVERAGE (SGPA)

A Semester Grade Point Average (SGPA) for the semester will be calculated according to the formula:

$$SGPA \frac{\sum [C \; X \; G]}{\sum C}$$

Where

C=number of credits for the course,

G=grade points obtained by the student in the course.

A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course.

CUMULATIVE GRADE POINT AVEARGE (CGPA)

A similar formula is used to arrive at Cumulative Grade Point Average (CGPA), considering the student's performance in all the courses taken in all the semesters up to the particular point of time. Table 3 shows the CGPA required for the award of class after the successful completion of the program.

Table3: CGPA required for award of Class

Class	**CGPA Required**
First Class with Distinction	≥8.0*
First Class	≥6.5
Second Class	≥5.5
Pass Class	≥5.0

*In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in first attempt.

11. REAPPEARANCE

a. A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent Semester end examination held for that course.
b. A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes scheduled by the Department for securing pass.
c. A student who has secured 'F' Grade in Internship /Project work / Industrial Training etc shall have to reappear for Viva – voce scheduled by the department.
d. A student who is declared fail (F) in a course/s can apply for revaluation within one week from the date of publication of results with a fee prescribed by the university.

The marks /grade awarded in the revaluation is final.

11.1 Procedure for revaluation

- The students who have not satisfied with the marks awarded by the examiner can apply for revaluation of his/her answer script/s
- The students have to apply through proper channel for revaluation and to pay the revaluation fee per paper to the university towards revaluation fee.
- Students have to apply for revaluation within 7 days from the date publication of result.
- The scripts will get valued by second examiner and if the difference is more than 15 marks, they will get valued by the third examiner. The average of the nearest two marks will be declared as the final marks.

11.2 ASSESSMENT MECHANISM

The Apollo University offers a student the benefits of Choice Based Credit System. Every paper is allotted a certain number of credits as per the UGC norms. A student is awarded the specified credits on obtaining a pass in the respective paper.

The Choice Based Credit System (CBCS) has been adopted for UG Course from the year 2021-22 onwards as per the recommendations of the A.P. State Council for Higher Education (APSCHE). The structure of undergraduate programmes provides a wide range of choice for students to opt for courses based on their eligibility, aptitude and career goals.

11.3 Semester End Examination

The End semester examination will be a comprehensive examination of 3 hours duration. Two End Semester examinations are conducted in a year-

Odd semester examinations in November/ December and

Even semester examination in May/June

Practical examination / Project viva will be held 2 weeks prior to the theory semester end examinations.

Under-Graduation Programs

Course	Continuous Assessment	End semester	Aggregate in End semester Examinations
All UG Courses	No passing minimum	40%	40%

11.4 Post Evaluation Programme:

Under the Post Evaluation Programme there are three menus:

- Provision for improvement
- Re-totaling and Revaluation of answer scripts
- Restrictions to appear for the examinations

11.5 Provision for improvement

A student who passes a paper in the first attempt can reappear for the same paper in the succeeding End-of-Semester examination only, for improving his/her marks. Re-appearance for improvement is allowed for theory and practical subjects of all semesters, except for the final semester subjects. Revised mark statement will be issued after withdrawing the previous one, if the marks obtained in improvement are higher than the marks awarded earlier. When there is no improvement, there shall not be any change in the original marks already awarded. The improved marks shall be considered for classification but not for ranking.

Provision for Re-totaling and Revaluation of valued answer scripts

- UG candidates may apply for re-totaling / revaluation of valued answer scripts, to the Controller of Examinations through the Heads of Departments and Principal / Dean, in the prescribed forms, remitting the prescribed fee within 7 days from the

date of publication of results. Revaluation of answer scripts is permissible only for the current semester papers and not for any arrear paper.

- Those wish to apply for revaluation of final semester papers can do so within five days from the date of publication of results. In re-valuation, the answer papers will be valued by an external examiner and if there is a difference of 15 marks between the two evaluations then the script will be sent for third valuation which is final and the mark awarded by the third examiner will be taken into the account.
- Revised mark statement will be issued after withdrawing the previous one, if the marks obtained in revaluation / retotalling are higher than the marks obtained earlier. In other cases, the original marks obtained earlier will be retained and the matter will be intimated to the student concerned as 'No change'.
- A candidate who applies for revaluation should not apply for retotalling.

Restrictions to appear for the examinations

Candidates who fail in any of the papers in the UG End semester examinations shall complete the paper concerned within N+2 years from the date of admission to the particular course. If they fail to do so, they shall re-register their names and take the examination in the texts/revised regulations/syllabus of the paper prescribed for the subsequent batch of candidates, in force at the time of their reappearance. In the event of removal of that paper consequent to change of regulation and/or curriculum after N+2 years period, the candidate shall have to take up an equivalent paper in the revised syllabus as suggested by the Chairman, Board of Studies concerned.

12. BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

13. DETENTION AND RE-ADMISSION

If a student fails to meet the minimum attendance requirement or minimum standards for academic progression, the concerned academic head will recommend for detention and it will be notified by the concerned Dean of the School. The students who are detained in the current semester will not be allowed to register for the next semester and they have to repeat the same semester.

The candidates who are detained or availed academic break or suspended in the previous semester/academic year and want to continue their study shall apply for re-admission to the university. The candidates shall request for re-admission to the respective Head of the Department, with details viz., Full Name, Registration Number, Department, School, Fee payment particulars with proofs and reasons for discontinuations. The concerned academic head will forward it to the Registrar with specific comments. The Registrar will notify the decision of re-admission which shall include the prescribed fee particulars, semester/ year into which readmission is granted and additional courses to be completed by the student (if any). The candidates should apply for re-admission in advance, that is before the commencement of the semester.

14. GROOMING AND ATTIRE FOR STUDENTS

Grooming and Etiquette is of great significance in the dynamic of shaping one's Personality. The Apollo University stands by a *Code of Grooming, Attire and Etiquette* that promotes a professional standard: Academic Day; Campus Placements and Non-Academic Hours on Campus.

The Dress Code to be in compliance on academic premises while attending: Formal Functions of the Institution / Lectures / Practicals / Dining Area / Library / Labs / Office Areas.

Students shall follow appropriate attire during Academic and Non-Academic hours on the campus. Students shall wear clean, neat, pressed and presentable clothing, and command respect by dressing in accordance with responsible personal norms. Students shall always wear The Apollo University ID Card with the Lanyard.

Grooming and Formal Wear - Boys:

Formal Shirts / T-Shirts with a Collar should preferably be tucked in with a Formal pair of Pants Shoes and Socks to complete the Formal Attire. Personal Hygiene should be followed and Hair should be well groomed.

Smart Casuals for Boys:

Long Kurtas / Formals / Semi-Formal Shirts with Jeans.

Grooming and Formal Wear - Girls: Sarees / Salwar Suits / Leggings or Jeggings with Long Kurtis / Long Frocks / Long Skirts / Palazzos. Complement the outfit with proper footwear. Personal Hygiene should be followed and Hair should be well groomed.

Smart Casuals for Girls:

Jeans with long Kurtis / Long Skirts / Long Frocks.

Attire for Non-Academic Hours On Campus:

The students should be neatly attired during Non-Academic Hours on Campus.

Dress Code for Boys:

Jeans / Track Suits / T-Shirts / Trousers / Shirts.

Dress Code for Girls:

Jeans / T-Shirts or Blouses / Salwar Suits / Palazzos / Leggings or Jeggings with Long Tops / Sarees / Long Skirts / Track Suits.

DO'S AND DO'NTS FOR BOYS AND GIRL STUDENTS OF THE UNIVERSITY:

- To wear modest clothing that reflects the essence of good personal grooming standards.
- To refrain from wearing Sleeveless Clothing; Shorts; Short Tops, etc.,

PLEASE NOTE: The decision as to what constitutes Appropriate Attire vests with the Authorities of The Apollo University.

15. ELIGIBILITY FOR AWARD OF THE DEGREE

The undergraduate degree will be of 3 years of duration. A student shall be declared as eligible for the award of the degree if the candidate has successfully secured the minimum number of required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

After successful completion of the program, a provisional certificate cum memorandum of grades (PCMG) will be issued to the students. The PCMG includes the secured grades and class achieved in chosen program and specialization if any, along with grades and CGPA secured by the student. The original degree will be presented in the subsequent convocation.

16. DISCRETION POWER

Not with-standing anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

ANNEXURE 1

ELIGIBILTY FOR QUALIFYING EXAM FOR UNDER GRADUATE PROGRAMS

Program Type	Program Name	Eligibility
Bachelor's	**B Sc., BMS – Biomedical Sciences**	Candidates must secure 50% in Botany, Zoology, Physics and Chemistry of Intermediate or in the diploma course or must have appeared for Class 12 or equivalent examination with Physics, Chemistry, and Biology as major subjects from any recognized board. Candidates who have completed or qualified the final year of Intermediate courses and should attain 17 Years as on 31st December of the preceding calendar year.

ANNEXURE 2

PROGRAMS OFFERED BY DEPARTMENT OF BIOMEDICAL SCIENCES

UNDER SCHOOL OF HEALTH SCIENCE

FROM ACADEMIC YEAR 2022-23

Sl. No.	Program	Expanded	Level	Minimum Duration in Years (N)
1	B Sc., BMS	Biomedical Science	Bachelor's	3

ANNEXURE 3

PROGRAMS OFFERED BY DEPARTMENT OF BIOMEDICAL SCIENCES

UNDER SCHOOL OF HEALTH SCIENCE

FROM ACADEMIC YEAR 2023-24

Sl. No.	Program	Expanded	Level	Minimum Duration in Years (N)
1	B Sc., BMS	Biomedical Science	Bachelor's	3

B.Sc. Biomedical Science
Course Structure
(2023-24 admitted batch)

I - Semester

3 Week Induction Programme						
Course Code	**Course Name**	**Periods per week**			**Credits**	**Hours per week**
		L	**T**	**P**		
BMST1501	Fundamentals of Biology	3	1	0	4	4
BMST1502	Cell Biology and Genetics	3	1	0	4	4
BMST1503	Data Science	3	1	0	4	4
TAUT1101	University Core – 1 Communicative English	3	0	0	3	3
TAUT1201	University Elective – 1	3	0	0	3	3
BMSL1501	Data Science Lab	0	0	4	2	4
BMSL1502	Fundamentals of Biology lab	0	0	4	2	4
--	Soft Skills	0	0	0	0	1
--	Mentoring	0	0	0	0	1
--	Technical Seminar	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
--	Co-curricular activity	0	0	0	0	1
--	Self-Learning	0	0	0	0	1
TOTAL		**15**	**3**	**8**	**22**	**36**

B.Sc. Biomedical Science
Course Structure
(2023-24 admitted batch)

II - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
BMST1504	Molecular Biology	3	1	0	4	4
BMST1505	Biochemistry	3	1	0	4	4
BMST1506	Medical Microbiology	3	1	0	4	4
TAUT1102	University Core – 2 Environmental Studies	3	0	0	3	3
TAUT1202	University Elective – 2	3	0	0	3	3
BMSL1503	Biochemistry Lab	0	0	4	2	4
BMSL1504	Microbiology Lab	0	0	4	2	4
--	Soft Skills	0	0	0	0	1
--	Mentoring	0	0	0	0	1
--	Technical Seminar	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
--	Co-curricular activity	0	0	0	0	1
--	Self-Learning	0	0	0	0	1
TOTAL		**15**	**3**	**8**	**22**	**36**

B.Sc. Biomedical Science
Course Structure
(2022-23 admitted batch)

III - Semester

Course Code	Course Name	Periods per week			Credits	Hours per week
		L	T	P		
BMST2507	Genetic Engineering	3	1	0	4	4
BMST2508	Immunobiology	3	1	0	4	4
BMST2509	Bioanalytical Techniques	3	1	0	4	4
BMST2510	Bioelectronics and Biosensors	3	1	0	4	4
TAUT2101	University Core – 3 Health and Wellness	3	0	0	3	3
TAUT2201	University Elective – 3	3	0	0	3	3
BMSL2504	Molecular Biology Lab	0	0	4	2	4
BMSL2505	Bioanalytical Techniques Lab	0	0	4	2	4
--	Technical Seminar	0	0	0	0	1
--	Library	0	0	0	0	1
--	Physical Activity	0	0	0	0	2
--	Extra-curricular activities	0	0	0	0	2
TOTAL		**18**	**4**	**8**	**26**	**36**

B.Sc. Biomedical Science
Course Structure
(2022-23 admitted batch)

IV - Semester

Course Code	Course Name	Periods per week				Number of Hours
		L	T	P	C	
BMST2511	Animal Cell Culture and Techniques	3	1	0	4	4
BMST2512	Molecular Diagnostics	3	1	0	4	4
BMST2513	Genomics, Proteomics and Computational Drug Design	3	1	0	4	4
BMST2514	Biomedical Instrumentation	3	1	0	4	4
BMST2601	Program Elective – 1	3	0	0	3	3
BMST2602	Program Elective – 2	3	0	0	3	3
BMSL2507	Genomics and Proteomics Lab	0	0	4	2	4
BMSL2508	Medical Instrumentation Lab	0	0	4	2	4
	Technical Seminar	0	0	0	0	1
	Library	0	0	0	0	1
	Physical Activity	0	0	0	0	2
	Extra-curricular activities	0	0	0	0	2
	TOTAL	**18**	**4**	**8**	**26**	**36**

B.Sc. Biomedical Science
Course Structure
(2022-23 admitted batch)

V - Semester

Course Code	Course Name	Periods per week				Number of Hours
		L	T	P	C	
BMST3515	Tools in Bioinformatics	3	1	0	4	4
BMST3516	Sem Cells and Cancer	3	1	0	4	4
BMST3517	Applications of Biotechnology	3	1	0	4	4
BMST3603	Program Elective – 3	3	0	0	3	3
BMST3604	Program Elective – 4	3	0	0	3	3
BMSP3501	Mini-project	0	0	12	6	12
	Technical Seminar	0	0	0	0	1
	Library	0	0	0	0	1
	Physical Activity	0	0	0	0	2
	Extra-curricular activities	0	0	0	0	2
	TOTAL	**15**	**3**	**12**	**24**	**36**

B.Sc. Biomedical Science
Course Structure
(2022-23 admitted batch)

VI - Semester

Course Code	Course Name	Periods per week				Number of Hours
		L	T	P	C	
BMST3605	MOOCs Course – 1	3	0	0	0	3
BMST3606	MOOCs Course – 2	3	0	0	0	3
BMSP3502	Major-project	0	0	36	18	36
	TOTAL	**06**	**0**	**36**	**18**	**36**

BMST1501: FUNDAMENTALS OF BIOLOGY **L T P C**

4 0 0 4

COURSE DESCRIPTION

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of Bio-Medical Science.

COURSE OBJECTIVES

- To Use anatomical terminology to identify and describe locations of major organs of each system covered.
- To Explain interrelationships among molecular, cellular, tissue, and organ functions in each system.
- To Describe the interdependency and interactions of the systems.
- To provide students with a comprehensive understanding of the basic principles and concepts of biology, including cell structure and function, genetics, evolution, and ecology.
- To develop students' ability to apply scientific methods and critical thinking skills to explore biological questions and solve problems in real-world contexts.

Unit 1: Diversity of Life: Recognize what living things do, their properties and processes, Introduction to photosynthesis and Respiration, Levels of Biological organization, Chemistry of life- Biomolecules and their Importance, Carbohydrates. Lipids, Proteins, Nucleic acids, Enzymes and Metabolism, Forms of energy, The Structure and Hydrolysis of ATP.

Unit II: Cell Structure and Function, the importance of cells, the first Prokaryotes, Comparing prokaryotic and eukaryotic cells, Panoramic view of Eukaryotic cells (plant & animal), Overview of cell organelles (identification), Brief functions of cell organelles. Tissue systems -Plant and animal tissue Structure and Function

Unit III: Diversity in Plant and Animal Kingdoms: Binomial and Hierarchical classification, Types of kingdoms, Universal tree of life, Introduction to animal diversity, Invertebrates, Vertebrates-Fishes/Amphibians/Reptiles/ Birds/Mammals, Plant diversity- Seed and Seedless Plants, Fungi

Unit IV: Transport in Plants and Animals: Membrane structure results in selective permeability, Passive transport, Active transport, Bulk transport, Plant structure, growth and development, Vascular transport in plants, Plant nutrition, Animal nutrition, Blood Composition and Function, Blood vessel Structure and Function, Circulation and Gas Exchange.

Unit V: Organs and Organ System: Organs and organ systems, Digestive system, Respiratory system, Excretory system, Reproductive system, Nervous system.

COURSE OUTCOMES –

Upon successful completion of the course student would be –

- Able to Explain morphology, structure and functions of organs of the human body.
- Able to Describe the various homeostatic mechanisms and their imbalances.
- Able to Identify the various tissues and organs of different systems of human body.
- Able to understand human organ anatomy, physiology and regulatory mechanisms.
- Able to Understand the challenges such as disease and stress.

Text Books

1.Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.

2.Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

Reference Text Books

1.Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA

2.Text book of Medical Physiology- Arthur C, Guyton and John .E. Hall. Miamisburg, OH, U.S.A.

3. Human Anatomy and Physiology, by Elaine N. Marieb and Katja N. Hoehn, ISBN13: 978-0134807423, 11th Edition

BMST1502: **CELL BIOLOGY AND GENETICS** **L T P C**

4 0 0 4

COURSE DESCRIPTION

In this course we will examine many different areas of cellular biology including: the synthesis and function of macromolecules such as DNA, RNA, and proteins; control of gene expression; membrane and organelle structure and function; bioenergetics; and cellular communication.

COURSE OBJECTIVES

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will understand the cellular components underlying mitotic cell division.
- Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
- Students will be equipped with a thorough understanding of the molecular and cellular mechanisms that govern genetic inheritance and cellular functions, and how these principles apply to the study of complex biological systems and diseases.

Unit - 1

Introduction - Definition of cell biology; history of cell biology;

Techniques in Cell Biology - Microscopy – light microscopy, electron microscopy, X-ray diffraction analysis; cell fractionation; autoradiography; cell culture; chromatography; electrophoresis; dialysis

Unit - 2

Cell - prokaryotic cells, eukaryotic cells, cell wall and plasma membrane, cytoplasm, nucleus; Cytoplasmic Matrix, Properties of cytoplasmic matrix; Plasma Membrane and Cell Wall Endoplasmic Reticulum (ER), Golgi Apparatus, Lysosomes, Microbodies, Mitochondria, Plastids

Unit- 3

Nucleus - Chromosomes - Ribosomes - Cytoskeleton; Microtubules, Microfilaments and Intermediate Filaments - Cilia and Flagella - Cell Growth and Cell Division - Reproduction - Fertilization - Growth

Unit - 4

Introduction, Genetical Terminology, Mendel and His Work, Genetic Interaction and Lethal Genes, Quantitative Genetics, Inbreeding, Outbreeding and Hybrid Vigour

Unit - 5

Linkage, Crossing Over, Genetic and Cytological Mapping of Chromosomes, Multiple Alleles, Fine Structure of Gene, Sex-linked Inheritance, Determination of Sex and Sex Differentiation, Chromosomal Mutations, Gene Mutation, Cytoplasmic or Extra-Nuclear Inheritance, Pedigree Analysis, Human Genetics, Eugenics and Genetic Engineering, Transposable Genetic Elements

COURSE OUTCOMES –

Upon successful completion of the course student would be –

- Able to describe the evolution, diversity and replication of cells;
- Able to explain the role of compartmentalization and signalling in cellular biology;
- Able to interpret and explain key experiments in the history of cell biology;
- Able to evaluate and apply knowledge of modern techniques in cellular biology.
- Able to interpret and explain about interactions, mapping and mutations in genes.

Text books

1. Essential Cell Biology, 7th edition (2009), Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts and Walter. Garland Science. ISBN-13:978-0815341291.

2. Molecular Cell Biology, 7th edition (2012), Lodish, Berk, Kaiser, Krieger, Bretscher, Ploegh, Amon and Scott. W. H. Freeman. ISBN-13: 978-1429234139

Reference Text books

1.Cell and Molecular Biology: Concepts and Experiments, 6th edition (2009), Gerald Karp, Wiley. ISBN-978-0470483374.

2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Freifelder, 2nd edition (1983), W. H. Freeman and Company.
3. An Introduction to Radiobiology, 2nd edition (1998), A. H. W. Nias, Wiley Blackwell, ISBN-13: 978-0471975908.

BMST1503: DATA SCIENCE **L T P C**

4 0 0 4

COURSE DESCRIPTION

This course provides a comprehensive introduction to computing, starting from binary representation and progressing to programming, data manipulation, linear algebra, and operating system concepts. It equips students with a deep understanding of the computational underpinnings of data science.

COURSE OBJECTIVES

- To provide students with a strong foundation in statistical analysis, machine learning, and data mining techniques for extracting meaningful insights from complex datasets.
- To develop proficiency in programming languages and tools commonly used in data science, such as Python.
- To enable students to design and implement data-driven solutions to real-world problems across various industries, including healthcare, finance, and technology.
- To teach students best practices for data collection, cleaning, preprocessing, and management to ensure the integrity and quality of data analysis.
- To enhance students' ability to communicate data findings effectively through visualizations, reports, and presentations, translating technical results into actionable business strategies.

Unit 1: Introduction to Computing

Early history of computing
Evolution of computing devices and current trends
Understanding binary representation
Hexadecimal and octal numbering systems
Programming Languages and Hardware Abstraction

Unit 2: Data Representation

Integer and floating-point representation
Character encoding (ASCII and Unicode)
Data structures and memory allocation
Data manipulation and storage

Unit 3: Programming Fundamentals

Introduction to Python functions and modules
Programming paradigms (imperative, procedural, object-oriented)
Control structures (if statements, loops)
Functions, scope, and lifetime of variables

Unit 4: Advanced Python Programming

More advanced Python topics (generators, comprehensions, decorators)
File handling and I/O operations
Error handling and debugging techniques
Algorithm design and analysis

Unit 5: Linear Algebra for Data Science

Vectors and matrices
Matrix operations (addition, multiplication)
Linear transformations
Eigenvalues and eigenvectors
Applications of linear algebra in data science

COURSE OUTCOMES

Upon the successful completion of this course, the students will be–

- Able to interpret model and data output in terms of the original biological problem, and use results to direct a follow-up experiment.
- Able to perform appropriate data manipulations, and graphically display model output and data clearly and accurately.
- Able to determine the roots of polynomial and transcendental equations by different methods
- Able to demonstrate the components of Vector algebra and Matrices
- Able to determine the Areas, Volumes and Surface using Calculus

Text Books

1. Python Data Science Handbook: Tools and Techniques for Developers, by Jake Vander Plas publishers O'Reilly Media, Inc. November 2016

2. Python for Data Analysis - Data Wrangling with Pandas, NumPy, and IPython by Wes McKinney was published by O'Reilly Media, Inc 2017

Reference Text Books

1. "Think Python - How to Think Like a Computer Scientist" by Allen B. Downey and was published by O'Reilly Media, Inc. 2012

2. "Learning Python" by Mark Lutz and David Ascher published by O'Reilly Media, Inc. 2003.

BMST1101: COMMUNICATIVE ENGLISH **L T P C**

3 0 0 3

COURSE DESCRIPTION

The creation of the Course is to facilitate Stakeholders in productively using the Language to functional advantage to form meaningful engagements in a social context and influence their professional dynamic.

COURSE OBJECTIVES

- Improve speaking ability in English both in terms of fluency and comprehensibility. Enlarge vocabulary by maintaining a Vocabulary Journal. Increase reading speed and comprehension of academic articles.
- Heighten awareness of the correct usage of English grammar in Writing and Speaking.
- Strengthen ability to write academic papers, essays and summaries using "Mind Mapping'.
- Develop skills that enable them to communicate effectively in English. To present ideas clearly and logically to achieve a specific purpose and to be appropriate for an intended audience
- Give Oral Presentations and receive Feedback on their performance.

UNIT – I **[10 HOURS]**

Vocabulary and Reading:

Special Features of English Vocabulary, Reading With Purpose; Understanding What is Read; Drawing a Conclusion Based on Inferences, Deduction, Reading Between the Lines, Context, Connotation, Higher Order Thinking; How to Explain Specific Information with Clarity; Defining and Giving Reasons; Giving Directions; Professional Vocabulary

COURSE OUTCOMES :

- Read for intensive information, retrieval and interpretation required by University studies
- Paraphrase information from outside sources effectively and accurately
- Summarize information from academic sources, distinguishing between main ideas and details.

UNIT – II **[10 HOURS]**

Basic Grammar:

Subject-Verb Agreement; Verb Tenses; Active-Passive Voice; Direct and Indirect Speech; Question Tags; Degrees of Comparison; Articles; Avoiding Jargon.

COURSE OUTCOMES :

- Review grammatical structures of English and how to functionally incorporate it into the 4 Skills dynamic.
- Use of the forms of Grammar in specific communicative contexts, which include: Session Activities, Group Discussions, Assignments.
- Reading of texts and writing of functional Grammar in real-world facets.

UNIT - III: **[10 HOURS]**

Writing:

Letter Writing; Report Writing; E-Communication, Drafting and Collating Key Information, Taking Notes from Lectures, Reading Materials, Reporting on Minutes of the Meeting, Precis Writing.

COURSE OUTCOMES :

- Practice writing through assignments that ask you to plan, draft, revise and edit your writings.
- Understand the demands of academic research, which means learning about our libraries and the print and electronic sources there and learning to develop good questions, find relevant sources, evaluate those sources and integrate them thoughtfully, responsibly, and ethically in your own writing.
- Write summaries in which they will communicate appropriately, accurately and effectively what has been read.

UNIT – IV **[10 HOURS]**

Basics of Communication:

Role of Communication, Purpose of Communication, Barriers of Communication, Verbal and Non-Verbal Communication, Communication at the workplace, Human Needs and Communication, Mind Mapping and E-Communication.

COURSE OUTCOMES :

- Understand and apply the communication theory.
- Critically think about the communication processes and messages.
- Engage in scholarly inquiry and social scientific research.

UNIT – V **[5 HOURS]**

Presentations:

Self-Introduction, Individual Presentation, Group Discussions, Debates.

COURSE OUTCOMES :

- Develop public speaking abilities by capitalizing on opportunities to speak in class, both informally and formally.
- Interact skilfully and ethically.
- Develop and deliver professional Presentations.

COURSE OUTCOMES

- Improve their accuracy and fluency in producing and understanding spoken and written English and endorse this proficiency in both personal and professional realms.
- Attain and enhance competence in the four modes of literacy: Writing, Speaking, Reading and Listening.
- Develop verbal and critical thinking aptitude.
- To be aware and informed on how to avoid plagiarism
- Recognize the effects of diversity, access, and power of communication.

ACADEMIC RESOURCES AND REFERENCES

- Scholarly Publications - Journals
- Popular Sources - Newspapers and Magazines
- Professional Sources
- Conference Proceedings
- Government Documents
- English Communications Skills for Professionals, By Gregory A. Barnes
- Wren and Martin Grammar
- Speaking Effective English! By Bettye Pierce Zoeller, John Watkins, and Hugh Lampman
- English Grammar In Use, By Raymond Murphy
- Essentials of English, Author Unknown
- Enhance Your English Fluency, By Karen
- Inculcate profound knowledge through BBC for practical, everyday use in business.
- Assess the skills of writing business letters in various situations and generate skills of writing business letters, essays and memos.
- Categorize the various structures of reports and compose to use them in the professional scenario.

Text Books

1. Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech & Jan Svartvik. A Comprehensive Grammar of the English Language. London: Longman, 1989

2. Communicative English for Engineers and Professionals by Nitin Bhatnagar & Mamta Bhatnagar New Delhi: Pearson / Longman

Reference Text Books

1. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and scientists. Delhi: PHI, 2009

2. A Textbook of English for Engineers and Technologists (combined edition, Vol. 1 & 2); Orient Black Swan 2010.

3. English Communications Skills for Professionals, by Gregory A. Barnes, ISBN13: 978-0844208589, 2nd Edition

BMSL1501	Data Science Lab	L	T	P	C
		0	0	4	2

1. Introduction to Python and Linux
Introduction to Python and its applications.
Overview of the Linux operating system.
Setting up a Linux environment (virtual machine or cloud instance)

2. Introduction to Linux Command Line
Basic Linux commands for navigation and file management.
File system hierarchy and paths.
Creating, copying, moving, and deleting files and directories.

3. Linux File Permissions and Ownership
Understanding file permissions.
Changing file permissions and ownership.
Managing user accounts.

4. Python Basics
Writing and running Python scripts.
Variables, data types, and assignments.
Basic input and output.

5. Control Structures
Conditional statements (if, elif, else).
Loops (for, while).
Combining control structures.

6. Functions and Modules
Defining and calling functions.
Function parameters and return values.
Importing and using Python modules.

7. Data Structures
Lists, tuples, and dictionaries.
Operations on data structures.
List comprehensions.

8. File Handling in Python
Reading and writing files.
File input/output operations.
Error handling with try-except.

BMSL1502: FUNDAMENTALS OF BIOLOGY LAB

L	T	P	C
0	0	4	2

List of All Experiments

1. Practical 1: Lab safety and Introduction to Equipment and Glassware
2. Practical 2: Basic Skill of the Microscope
3. Practical 3: Focusing an optical microscope.
4. Practical 4 : Identification Tests for Carbohydrates and Lipids
5. Practical 5: Identification Tests for Amino acids, Proteins and Nucleic Acids
6. Practical 6: Observation and Biological Drawing of Plant Cells
7. Practical 7: Observation and Biological Drawing of Animal Cells
8. Practical 8: Anatomy of Vascular and Non-Vascular Plants
9. Practical 9: Identification of Animal Phyla Based on Characteristics
10. Practical 10: Diffusion and Osmosis
11. Practical 11: Transpiration
12. Practical 12: The Transport of Water through Xylem: Stain Test
13. Practical 13: Human Heart and Blood Circulation
14. Practical 14: Vertebral Animal Tissues

BMST1504 **MOLECULAR BIOLOGY** **L T P C**

4 0 0 4

COURSE DESCRIPTION

This course offers an in-depth study of the molecular mechanisms that underlie biological processes in living organisms. Students will explore the structure and function of nucleic acids and proteins, gene expression and regulation, DNA replication, repair, and recombination, as well as techniques used in molecular biology research. The course integrates theoretical knowledge with practical laboratory skills, emphasizing the application of molecular biology concepts to biotechnology, medicine, and genetic engineering. Through lectures, laboratory exercises, and research projects, students will gain a comprehensive understanding of how molecular biology drives the complexity of life at the cellular and molecular levels.

COURSE OBJECTIVES:

- To understand concepts of genetic material and gene organization
- To understand the concepts of bacterial genetics
- To comprehend mutation and DNA repair mechanism
- To provide students with a detailed understanding of the molecular mechanisms governing the structure, function, and regulation of nucleic acids and proteins.
- To develop students' practical laboratory skills in molecular biology techniques, enabling them to apply these methods to research and biotechnological applications.

UNIT 1: Chemical Basis of Heredity and Genome Organization

Introduction, Experimental proof of DNA and RNA as genetic material; Structure and functions of DNA and RNA; Watson and Crick model of DNA and other forms for DNA, A and Z; Functions of DNA and RNA including Ribozymes; Prokaryotic genome Chromosomal and plasmid; Eukaryotic genome chromosomal DNA organization.

UNIT 2: Replication and Transcription in prokaryotes and eukaryotes

DNA Replication in Prokaryotic and Eukaryotic, Enzymes and proteins involved in replication, Gene, Gene expression, Mechanism of transcription Initiation elongation and

termination in prokaryotes and eukaryotes; promoters; RNA polymerase, transcription factors, Post transcriptional; Transcriptional inhibitors; Modifications of eukaryotic mRNA 5' capping and 3' poly A tailing; mRNA Splicing.

UNIT 3: Translation and Regulation of Gene Expression

Ribosomes; Genetic code, Features and Wobble hypothesis; Mechanism of translation in Prokaryotes and Eukaryotes, Post translational modifications of proteins. Regulation of Gene expression in Prokaryotes Operon concept, Lac operon and Tryptophan operon.

UNIT 4: Bacterial Genetics

Recombination in Prokaryotes Conjugation; F+, F-, Hfr and F' Cells, Transformation; Griffith's experiment and mechanism, Transduction; Generalized and Specialized; Bacterial Transposons.

UNIT 5: Mutation, DNA damage and repair

Types of mutations Base substitution, Frame shift mutation; Mutagens Physical & Chemical Mutagens; Reverse mutation in bacteria; DNA repair mechanism, Mismatch repair, photo reactivation, excision and SOS repair; Beneficial and harmful effects of mutations.

COURSE OUTCOMES

After successful completion of the program, the student will be able to

1. Acquire a broad understanding of current molecular genetics and genomics including current areas of research and research methodologies.
2. Identify important outstanding problems in molecular genetics and genomics and to plan research to address these problems.
3. Organize and present research plans and results to an audience, including preparation of research proposals and manuscripts for publication in scientific journals.
4. Explain the molecular processes of DNA replication, transcription, translation, and gene regulation, and how these processes contribute to cellular function and organismal development.

5. Perform key molecular biology techniques, such as PCR, gel electrophoresis, and cloning, and apply these methods to experimental research and problem-solving in biotechnology and genetics.

Text Books

1. Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2000) An Introduction to Genetic Analysis (7th Ed.), Freeman, New York.
2. Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. & Veres, R. C. (2000) Genetics: From Genes to Genomes,Tata McGraw Hill, New Delhi.

Reference Books

1. Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D.(2000).Molecular Cell Biology (4th Ed.). Freeman. New York.
2. Lodish, J. H & Baltimore, D. (1990).Molecular Cell Biology (2nd Ed.), Scientific American Books, New York.
3. Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. & Weiner, A. M. (1987). Molecular Biology of the Gene (4th Ed.), Benjamin Cummins, Menlo Park.

BMST1505 **BIOCHEMISTRY** **L T P C**

4 0 0 4

Course Description:

This course delves into the chemical processes and substances that occur within living organisms. Students will study the structure and function of biomolecules, metabolic pathways, and the regulation of biochemical processes. Emphasis is placed on understanding the molecular basis of life and the application of biochemistry in health, disease, and biotechnology.

COURSE OBJECTIVES

1. To explain concepts and principles of Biochemistry and Microbiology
2. To describe structures, classification morphology and growth of bacteria.
3. To describe the methods of infection control.
4. To identify the role of nurse in hospital infection control programme.
5. To provide students with a comprehensive understanding of the chemical principles underlying biological processes, equipping them with foundational knowledge for careers in medicine, research, and biotechnology.

Unit - 1

Chemical Constituents of Life - Biomolecules and the cell, Carbohydrates, Lipids, Proteins and amino acids, Nucleic acids and nucleotides, Enzymes, Vitamins

Unit - 2

Enzymes and Bioenergetics - Enzymes: Classification and Mode of Action, Kinetics of enzyme-catalysed reaction, Brief Introduction to Bioenergetics

Unit- 3

Metabolisms - Introduction to metabolism, Metabolism of carbohydrates, Metabolism of lipids, Metabolism of amino acids

Unit - 4

Integration of metabolism, Metabolism of nucleotides, Mineral metabolism

Unit – 5

Clinical Biochemistry and Nutrition - Hormones, Organ function tests, Water, electrolyte and acid-base balance, Tissue proteins and body fluids, Nutrition

COURSE OUTCOMES –

Upon successful completion of the course student would be –

1. Able to describe the chemistry of carbohydrates, lipids, proteins and nucleic acids
2. Able to describe the classification and structural organization of proteins
3. Able to describe the classification and mechanism of enzyme action
4. Able to describe the catabolic reactions of carbohydrates, lipids and amino acids
5. Able to describe the metabolic inborn errors

Text Books

1. Lehninger Principles of Biochemistry, 5thedition (2012), David L. Nelson and Michael M. Cox; W. H. Freeman, ISBN-13: 978-0716771081.

2. Principles and Techniques of Practical Biochemistry, 5thedition (2000), Keith Wilson and John Walker; Cambridge University Press, ISBN -13: 978-0521799652..

Reference Text Books

1. "Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer ISBN: 978-1319114657.

BMST1506 **MEDICAL MICROBIOLOGY** **L T P C**

4 0 0 4

COURSE DESCRIPTION

This course will also focus on mechanisms of microbial pathogenesis and the host response, and the scientific approaches that are used to investigate these processes. The course deals with the problem of emerging antimicrobial resistance with reference to known pathogens.

COURSE OBJECTIVES

1. To provide students with a comprehensive understanding of microbial pathogens, including bacteria, viruses, fungi, and parasites, and their roles in infectious diseases.
2. To develop proficiency in laboratory techniques for the isolation, identification, and characterization of medically important microorganisms.
3. To explore the mechanisms of microbial pathogenesis, including virulence factors, host-pathogen interactions, and the immune response to infections.
4. To enable students to apply knowledge of medical microbiology to diagnose, treat, and prevent infectious diseases in clinical and public health settings.
5. To explore the role of microorganisms in gut health

UNIT I: FUNDAMENTAL CONCEPTS **(12 Hours)**

INTRODUCTION, HISTORY & SCOPE OF MICROBIOLOGY 8 Introduction and history & developments of microbiology, scope of microbiology, general characteristics of prokaryotes and eukaryotes, classification of prokaryotes, introduction to mycology, virology and parasitology

STERILIZATION AND DISINFECTION Introduction and its types, principle, procedure and its application, definition and types of disinfectant, quality control for sterilization and disinfection, biosafety in microbiology lab, biowaste management

MICROBIAL NUTRITION AND GROWTH Different types of culture medium: continuous culture and synchronous growth cultures, aerobic & anaerobic culture and Growth kinetics.

UNIT II: BACTERIOLOGY (12 Hours)

STRUCTURE OF BACTERIAL CELL structure and functions of gram positive and gram-negative bacteria, cell wall, cell membrane, cytoplasmic inclusions and mesosomes, flagella, capsule, ribosome, chromosome, plasmid and endospore, morphological classification of bacteria

Introduction and its types, various affecting factors on microbial growth

Bacterial Diseases (with reference to Etiology, clinical symptoms, virulence factors involved, detection and prevention) Respiratory tract infections: Diphtheria and Tuberculosis, Gastrointestinal tract infections, staphylococcal food poisoning and *E. coli* gastroenteritis, Urinary tract infections: gonorrhea and Syphilis.

UNIT III: MEDICAL MYCOLOGY (12 Hours)

Pathogenic Fungi: Pathogenicity, clinical picture, laboratory diagnosis, prevention; Introduction: Pathogenic and opportunistic fungi, classification, antifungal agents. Superficial mycoses: Piedra, tinea versicolor; Cutaneous mycoses: Dermatophytosis, candidiasis; Subcutaneous mycoses: Mycetoma, Systemic mycoses: Histoplasmosis; Opportunistic mycoses: Otomycosis, pulmonary aspergillosis

General and detailed life cycle of *Aspergillus* and *Candida albicans* in relation to human diseasescaused by them.

Classification of medically important parasites. Common protozoan disease: Malaria, Infectionscaused by *Taenia Solium, Fasciola hepatica and Ascaris lumbricoides*.

UNIT IV

Viruses, viroids, prions

General characteristics of viruses, structure, isolation, cultivation and identification of viruses, viral multiplication, one step multiplication curve, lytic and lysogenic phages (lambda phage), Viroid's and prions.

Pathogenic Viruses: RNA Viruses: Poliomyelitis virus, influenza virus, Rabies virus; DNA Viruses: Variola, adenoviruses, papilloma virus; Viral Hepatitis: Hepatitis viruses, A, B, C, D, E. Rota virus; SARS virus; Corona virus; Human Immuno Deficiency Virus (HIV).

NOSOCOMIAL INFECTIONS Introduction and its types, pathogenicity and laboratory diagnosis of nosocomial infection, prevention and control of nosocomial infections

UNIT V: PRINCIPLES OF DISEASES (12 Hours)

CHEMOTHERAPY AND CHEMOTHERAPEUTIC AGENTS Introduction, types of chemotherapeutic agents, mode of action and clinical importance of different chemotherapeutic agents, antibiotic sensitivity tests and its medical importance, introduction, types, mode of action and importance of multiple drugs resistance, mechanism of drug resistance

NORMAL MICROBIAL FLORA AND PATHOGENIC MICROORGANISMS Normal microbial flora of the human body, collection and transport of specimens, processing of clinical specimens for microbiological examination

COURSE OUTCOMES

Upon successful completion of this course the student will be able to

- identify common infectious agents and the diseases that they cause
- evaluate methods used to identify infectious agents in the clinical microbiology
- recall microbial physiology including metabolism, regulation and replication
- explain general and specific mechanisms by which infectious agent causes disease
- recognize and diagnose common infectious diseases from the clinical presentation and associated microbiology

Text Books

1. Microbiology: An Introduction, 9th edition (2008), Gerard J. Tortora, Berdell R. Funke, Christine L. Case; Benjamin Cummings. ISBN-13: 978-0321733603.
2. Prescott, Harley, and Klein's Microbiology, 8th edition, (2011), Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw Hill International. ISBN-13:978- 0071313674.

Reference Text Books

1. Bailey and Scott's Diagnostic Microbiology, 12th edition (2007), Betty A. Forbes, Daniel F. Sahm and Alice S. Weissfeld; Mosby Elsevier Publishers, ISBN-13: 978-0808923640.
2. Microbiology, 6th edition (1993), Pelczar, Chan and Krieg; McGraw Hill International, ISBN-13: 978-0070492585.
3. Brock Biology of Microorganisms, 13th edition (2010), Michael T. Madigan, John M. Martinko, David Stahl and David P. Clark, Pearsons, Benjamin Cummings, ISBN-13: 978-0321649638.

TAUT1102: ENVIRONMENT STUDIES L T P C

3 0 0 3

Course Description:

This course examines the complex relationships between humans and their environment, focusing on ecological principles, sustainability, and the impact of human activities on natural systems. Students explore environmental issues such as climate change, biodiversity loss, pollution, and resource management, and examine solutions for promoting environmental conservation and sustainable development.

COURSE OBJECTIVES

1. To Gain in-depth knowledge on natural processes that sustain life, and govern economy.
2. To Predict the consequences of human actions on the web of life, global economy and quality of human life
3. To educate students about the fundamental concepts of ecology, environmental science, and sustainability.
4. To raise awareness about global environmental issues, including climate change, biodiversity loss, pollution, and resource depletion.
5. To foster critical thinking and problem-solving skills for addressing environmental challenges through interdisciplinary approaches.

Unit 1: Multidisciplinary nature of environmental studies (10 Hours)

Definition, scope and importance, Need for public awareness.

Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies.

Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

• Role of an individual in conservation of natural resources.

• Equitable use of resources for sustainable lifestyles.

Unit 2: Ecosystems (10 Hours)

• Concept of an ecosystem

• Structure and function of an ecosystem.

• Producers, consumers and decomposers.

• Energy flow in the ecosystem.

• Ecological succession.

• Food chains, food webs and ecological pyramids.

• Introduction, types, characteristic features, structure and function of the following ecosystem:-

a. Forest ecosystem

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3: Biodiversity and its conservation (10 Hours)

• Introduction – Definition: genetic, species and ecosystem diversity.

• Biogeographical classification of India

• Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values

• Biodiversity at global, National and local levels.

• India as a mega-diversity nation

Unit 4: Environmental Pollution (10 Hours)

Definition

• Cause, effects and control measures of:-

a. Air pollution

b. Water pollution

c. Soil pollution

d. Marine pollution

e. Noise pollution

f. Thermal pollution

g. Nuclear hazards

• Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

• Role of an individual in prevention of pollution.

• Pollution case studies.

• Disaster management: floods, earthquake, cyclone and landslides.

Human Population and the Environment

• Population growth, variation among nations.

• Population explosion – Family Welfare Programme.

• Environment and human health.

• Human Rights.

• Value Education.

• HIV/AIDS.

• Women and Child Welfare.

• Role of Information Technology in Environment and human health.

• Case Studies.

Unit 5: Social Issues and the Environment (10 Hours)

• From Unsustainable to Sustainable development

• Urban problems related to energy

• Water conservation, rain water harvesting, watershed management

• Resettlement and rehabilitation of people; its problems and concerns. Case Studies

• Environmental ethics: Issues and possible solutions.

• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act.
• Water (Prevention and control of Pollution) Act
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation.
• Public awareness.

Field work **(10 Hours)**

• Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc.

COURSE OUTCOMES

Upon successful completion of the course student would be –

1. Able to develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
2. Able to acquire values and attitudes towards understanding complex environmental-economicsocial challenges, and participating actively in solving current environmental problems and preventing the future ones.
3. Able to Adopt sustainability as a practice in life, society and industry
4. Able to Understand and evaluate the global scale of environmental problems; and
5. Able to Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Text book

1. Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education, Erach Bharucha for University Grants Commission, 2004
2. Odum, E.P., Odum, h.T. & Andrews, J.1971. Fundamentals of Ecology. Philadelphia: Saunders.

Reference Text Books

1. Singh, J.S., Singh, S.P. and Gupta, S.R. 2017. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
2. Sodhi, N.S., Gibson, L. andRaven, P.H. (Eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
3. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century

BMSL1501: BIOCHEMISTRY LAB **L T P C**

0 0 4 2

1. Qualitative test for carbohydrates.
2. Qualitative analysis of amin acids/proteins
3. Qualitative analysis of lipids
4. Hydrolysis of sucrose and starch
5. Saponification Value
6. Isolation of casein from milk
7. Estimation of glucose by benedicts method
8. Estimation of proteins by Lowry's method
9. Separation of amino acids and sugars by paper/thin layer chromatography
10. Study the effect of temperature on the activity of enzyme.
11. Study the effect pH on the activity of enzyme.

BMSL1502: MICROBIOLOGY LAB **L T P C**

0 0 4 2

1. Microscopy and Staining Techniques

2 To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.

3. Preparation of culture media for bacterial cultivation

4. Sterilization of medium using Autoclave and assessment for sterility

5. Sterilization of glassware using Hot Air Oven and assessment for sterility

6. Isolation of pure cultures of bacteria by streaking method

7. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods.

8. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data

9. Effect of temperature, pH, salt, carbon and nitrogen sources on growth of E.coli

10. Demonstration of alcoholic fermentation

11. Demonstration of the thermal death time and decimal reduction time of E. coli

BMST2507 **GENETIC ENGINEERING** **L T P C**

4 0 0 4

Course Description

This course explores the principles and techniques of manipulating genetic material at the molecular level for various applications. Students will learn about gene cloning, recombinant DNA technology, gene editing tools like CRISPR-Cas9, and the ethical implications of genetic engineering. Emphasis is placed on hands-on laboratory skills and the application of molecular genetic techniques in biotechnology, medicine, and agriculture

Course Objectives:

1. To impart knowledge about major events in the development of rDNA technology
2. To acquire skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest.
3. To familiarize with the concepts of constructing genomic DNA library and cDNA library
4. To understand the principles and applications of Polymerase Chain Reaction (PCR).
5. To explore the applications of Genetic Engineering in diseases diagnosis

Unit I: Gene expression and regulation: Replication, requirements and mechanism, Transcription-requirements and mechanism, Translation- requirements and mechanisms in prokaryotes and in eukaryotes, regulation of gene expression- lac and trp operon

UNIT -II: Requirements and steps involved in gene cloning, Isolation of gene/DNA fragments- Purification of genes: Mechanical shearing, restriction digestion, cDNA synthesis, and chemical synthesis of gene. Enzymes involved in gene cloning: ligases, nucleases: Restriction enzymes - Outlines of bacterial restriction and modification systems – Classification of restriction enzymes - Type II restriction enzyme: Nomenclature, Production of DNA fragments with cohesive ends and blunt ends and their significance.

UNIT – III: Vectors -Plasmids, Bacteriophages, cosmids, bacterial artificial chromosomes (BACs), yeast artificial chromosomes (YACs) - vectors for construction of cDNA libraries - lamda ZAP. Multipurpose vectors - pUC 18/19, Blue script vectors - multiple cloning site - Site directed mutagenesis. Expression vectors – structure - promoters used in

expression vectors - lac, tac, λpL, T7 promoters and their significance in constructing expression vectors. Vectors used for cloning into mammalian cells - SV40. Plant cloning vectors- Ti and Ri vectors.

UNIT - IV: DNA libraries- cDNA synthesis - Mechanism of cDNA synthesis, Strategies used to obtain full length cDNA. Chemical synthesis - solid phase synthesis of oligonucleotides - Designing of gene from amino acid sequences, In vitro synthesis of gene, Genomic DNA library, Nucleic acid hybridization- Probe, radiolabeling, Blotting techniques- southern, western and northern blotting.

UNIT - V: Cloning strategies: Introduction of cloned genes into host - Transformation, transduction, transfection, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery. Identification and screening of transformed cells. PCR - Concept and technology- Properties of primers -Taq DNA polymerase and its significance Inverse, multiplex PCR, RAPD, RFLP, AFLP and its significance. Real time PCR. Applications of genetic engineering

COURSE OUTCOMES

1. Able to understand the role of genetic engineering in medical research and the development of therapies for genetic diseases, cancer, and other health conditions.
2. Able to Address ethical, legal, and regulatory issues related to genetic engineering, including biosafety and bioethics.
3. Able to Provide hands-on laboratory experience in genetic engineering techniques, including the cloning of genes and the manipulation of DNA.
4. Able to Foster critical thinking skills to address real-world problems in genetic engineering and molecular biology.
5. Able to explain the principles of Genetic Engineering in Medicine

Text books

1. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, et al.
2. Genentech: The Beginnings of Biotech by Sally Smith Hughes
3. CRISPR-Cas: A Laboratory Manual by Jennifer A. Doudna and Prashant Mali

Reference Books

1. Genetic Engineering: Principles and Methods by Jane K. Setlow and Alexander Hollaender
2. Introduction to Genetic Engineering by Desmond S. T. Nicholl

BMST2508 **IMMUNOBIOLOGY** **L T P C**

4 0 0 4

Course Description:

This course delves into the study of the immune system, its components, functions, and interactions with pathogens and diseased cells. Students will explore the molecular and cellular basis of immune responses, immune regulation, immunodeficiencies, and immunotherapy. Practical aspects include laboratory techniques for studying immune cells and molecules, with an emphasis on understanding how immunobiology impacts health and disease.

Course Objectives:

- Understand the fundamental principles of immunology, including the structure and function of immune cells, tissues, and molecules.
- Analyze the mechanisms of immune responses to pathogens, allergens, and cancerous cells.
- Evaluate the roles of genetics, environment, and immunological memory in shaping immune responses.
- Explore the applications of immunobiology in vaccine development, immunotherapy, and personalized medicine.
- Critically assess current research and emerging trends in immunobiology and their implications for healthcare.

Unit I Overview of Immunity

Overview of the immune system, Historical perspective on immunology, Components of the immune system (innate and adaptive), Barrier Immunity, Antigens and antibodies, Haptens.

Unit II Innate Immunity & Adaptive Immunity

Immune cells and their functions, Phagocytosis and macrophages, Complement system, Natural killer (NK) cells, Inflammation and its role in innate immunity, B-cells and T-cells, Immune reponse types , Antibody structure and function, Major Histocompatibility Complex (MHC) and antigen presentation

Unit III Adaptive Immunity

B cells and antibody-mediated immunity, B cell development and activation, T cells and cell-mediated immunity, T cell development and activation, Types of T cells (CD4+ and CD8+), Cytotoxic T cells and helper T cells.

Unit IV The recognition of antigen and Immune regulation

Humoral Immune response, Cell mediated immune response, Antigen Recognition by B-cell and T-cell Receptors, The Generation of Lymphocyte Antigen Receptors, Antigen Presentation to T Lymphocytes, development of mature lymphocyte receptor, Lymphocyte Receptor Signaling

Unit V The Immune System in Health and Disease

Immunodeficiency disorders, Autoimmunity and autoimmune diseases, Allergies and hypersensitivity reactions, Vaccination and immunization, Failures of Host Défense Mechanisms, Allergy and Allergic Diseases, Transplantation immunology - Manipulation of the Immune Response, Infectious diseases and immunology, Emerging trends in immunology research

COURSE OUTCOMES :

Upon successful completion of the course, the student would be able to –

- Demonstrate knowledge of the cellular and molecular mechanisms underlying immune responses and immune regulation.
- Apply immunological principles to diagnose and treat immunological disorders and infectious diseases.
- Perform laboratory techniques, such as flow cytometry and ELISA, to analyze immune cells and molecules.
- Communicate effectively about immunological concepts and research findings through oral presentations and written reports.
- Collaborate effectively in interdisciplinary teams to address complex immunological problems and propose innovative solutions.

Textbooks:

1. "Kuby Immunology" by Judy Owen, Jenni Punt, and Sharon Stranford

2. "Immunobiology" by Charles Janeway, Paul Travers, Mark Walport, and Mark Shlomchik
3. "Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai

BMST2508 BIOANALYTICAL TECHNIQUES L T P C

4 0 0 4

Course Description:

This course focuses on the principles and applications of modern bioanalytical techniques used in biological and pharmaceutical sciences. Students will learn theoretical foundations and practical skills in spectroscopy, chromatography, mass spectrometry, electrophoresis, and immunoassays. Emphasis is placed on method development, validation, and data analysis for quantifying biomolecules and understanding their interactions in biological systems.

Course Objectives:

1. Understand the principles and instrumentation of bioanalytical techniques commonly used in biological and pharmaceutical research.
2. Develop proficiency in experimental design, sample preparation, and calibration methods for quantitative analysis of biomolecules.
3. Learn to troubleshoot and optimize bioanalytical methods to enhance sensitivity, accuracy, and precision.
4. Explore the application of bioanalytical techniques in drug discovery, pharmacokinetics, and biomarker research.
5. Understand regulatory guidelines and ethical considerations in bioanalytical method development and validation.

UNIT-I

Chromatography: General Principles. Modes of chromatography. Principles, chromatographic media and applications of the following types of chromatography: Ion-exchange, Gel permeation, Affinity, Gas-Liquid, HPLC.

Electrophoresis: General principles. Polyacrylamide and agarose gel electrophoresis. Isoelectric focusing. 2DGE. Pulse field gel electrophoresis. Capillary electrophoresis.

Centrifugation: Principles. Differential centrifugation. Density gradient centrifugation.

Radioisotope techniques: Principles, measurement and applications of radioactivity.

UNIT-II

UV-Visible Spectroscopy: Principles, instrumentation and applications.

Turbidimetry and Nephelometry: Principles and applications.

Infrared and Raman Spectroscopy: Principles, instrumentation and applications.

UNIT-III

Spectro-fluorimetry: Basic principles. Uses of Fluorescence parameters, intensity, wavelength dependence, quantum yield, lifetime, polarization and rate of resonance energy transfer with emphasis on DNA sequencing, Fluorescence Immunoassays, and Molecular beacons. Mass spectrometry: Basic Principles. Ionization techniques with emphasis on EI, FAB, Electrospray and MALDI. Analyzers with emphasis on Magnetic sector, quadrupole and TOF. FTICRMS.

Applications of MS– determination of relative molecular mass, empirical formula, small molecule structural analysis, peptide sequencing and protein identification for proteomic studies.

UNIT-IV

ESR spectroscopy: Principles and applications.

NMR spectroscopy: Principles of magnetic resonance. Use of NMR parameters chemical shift, coupling constants and areas for structural elucidation. Nuclear Overhauser effect. Principles of FTNMR and 2D-NMR. Introduction to Protein structure determination by NMR. Principles of MRI and MR-spectroscopy.

UNIT-V

Electrochemical methods: Principles of potentiometry. Clark's oxygen electrode.

Biosensors: Principles and applications of electrochemical, thermometric, optical and piezoelectric biosensors. Glucose biosensors.

Microarrays: Basic principles. Introduction to different types. Methods of manufacture. Applications – differential expression, SNP analysis.

COURSE OUTCOMES :

1. Able to have a solid understanding of the principles and applications of bioanalytical techniques.
2. Able to Gain practical experience in using various bioanalytical instruments and methods.

3. Able to Develop the ability to quantitatively and qualitatively analyze biological samples.
4. Able to draw conclusions from bioanalytical data.
5. Able to Understand and implement quality control measures and good laboratory practices.

Textbooks:

1. Practical biochemistry. Principles and Techniques. Keith Wilson and John Walker. 1994. 5th ed. Cambridge University Press.

2. Biophysical chemistry. Principles and Techniques. Upadhyay, Upadhyay and Nath. 11th ed. Himalaya Publishing House.

3. Molecular biology and biotechnology. Walker and Rapley. (for Biosensors). 4th ed. 2003.

BMST 2510 BIO-ELECTRONICS AND BIOSENSORS L T P C

4 0 0 4

Course Description

The "Bio-Electronics and Biosensors" course provides an in-depth exploration of the principles and applications of bioelectronics and biosensor technologies. Students will learn about the design, fabrication, and functioning of biosensors and bioelectronic devices, and how these technologies are used to detect and measure biological signals. The course covers various types of biosensors, including electrochemical, optical, and piezoelectric sensors, as well as the integration of these sensors into electronic systems for medical diagnostics, environmental monitoring, and industrial applications. Through lectures, laboratory sessions, and project work, students will gain both theoretical knowledge and practical skills in the field of bioelectronics and biosensors.

Course Objectives

1. Understand Basic Principles: To provide a comprehensive understanding of the fundamental principles of bioelectronics and biosensors.
2. Design and Fabrication: To teach students the methods and techniques used in the design and fabrication of biosensors and bioelectronic devices.
3. Application Areas: To explore the diverse applications of bioelectronics and biosensors in medical diagnostics, environmental monitoring, and industrial processes.
4. Hands-on Experience: To offer practical experience in the use of bioelectronic devices and biosensors through laboratory exercises and projects.
5. Evaluate Performance: To develop skills in evaluating the performance and effectiveness of different types of biosensors and bioelectronic systems.

Unit 1: Foundations of Electronics and Introduction to Bio-Sensors Overview of Electronics and Its Role in Biosensors

Basic Concepts: Voltage, Current, Resistance, and Ohm's Law

Electronic Components: Resistors, Capacitors, and Diodes Introduction to Circuits and Circuit Elements Series and Parallel Circuits

Introduction to Sensor Types and Their Significance

Unit 2: Building Blocks of Biosensors: Diodes and Transistors
Understanding Diodes and Their Role in Signal Manipulation
Introduction to Transistors: Making Things Work with Switches
Applications of Diodes and Transistors in Biosensors

Unit 3: Signal Amplification and Conditioning
Importance of Signal Amplification in Biosensors
Introduction to Operational Amplifiers (Op-Amps)
Signal Conditioning for Biosensor Signals

Unit 4: Sensor Interfacing and Biosensor Integration
Integrating Sensors with Electronics: Temperature, Light, Pressure
Transducers and Their Role in Converting Physical Signals
Interfacing Biosensors with Electronic Circuits

Unit 5: Biosensors in Action and Future Directions
Exploring the Practical Applications of Biosensors
Enzyme-Based Biosensors
Emerging Trends in Biosensor Technology
Ethical Considerations in Biosensor Development

COURSE OUTCOMES

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

1. Explain Fundamental Concepts: Demonstrate a thorough understanding of the basic principles underlying bioelectronics and biosensor technologies.
2. Design Biosensors: Design and fabricate various types of biosensors and bioelectronic devices, understanding the materials and methods involved.
3. Apply Technologies: Apply bioelectronic and biosensor technologies to real-world problems in healthcare, environmental monitoring, and industrial applications.
4. Perform Experiments: Conduct experiments using bioelectronics and biosensors, accurately measuring and interpreting biological signals.

5. Assess Sensor Performance: Critically evaluate the performance, accuracy, and reliability of different biosensors and bioelectronic systems, proposing improvements where necessary.

Text Books

1. Introduction to Bioelectronics by Paolo Facci
2. Bioelectronics: From Theory to Applications by Paolo Facci and Marco Sami
3. Bioelectronics Handbook: MOSFETs, Biosensors, and Neurons by Meshack, I. Jangir

Reference Books

1. Bioelectronic Medicine: Wireless Implantable Devices by Vojkan Jovic, Brian Litt, and Greg E. Dudley
2. Bioelectronics by Albert van der Berg
3. Biomedical Instrumentation: Technology and Applications by R. Khandpur

BMST2511 ANIMAL CELL CULTURE AND TECHNIQUES L T P C

4 0 0 4

Course Description:

This course provides a comprehensive overview of techniques used to cultivate and manipulate animal cells in vitro. Students will learn principles and practices of cell culture, including media preparation, cell line establishment, maintenance, and characterization. Emphasis is placed on applications in biotechnology, drug development, and research in cell biology and medicine.

Course Objectives:

1. Understand the principles of animal cell culture, including cell biology, growth kinetics, and culture environments.
2. Develop proficiency in sterile technique, media formulation, and maintaining cell viability and purity.
3. Learn techniques for cell line establishment, cryopreservation, and cell-based assays.
4. Explore the application of cell culture techniques in biopharmaceutical production and regenerative medicine.
5. Evaluate ethical considerations and regulatory guidelines in animal cell culture research and applications.

UNIT - 1

History of Development of Cell Culture, Natural Surroundings of Animal Cell, Metabolic Capabilities of Animal Cell, Simulating Natural Conditions for Growing Animal Cells

UNIT - 2

Serum and Serum Free Media, Cell Culture System, Secondary Culture: Transformed Animal cell, Commonly used Cell Lines and their Uses

UNIT - 3

Growth Kinetics of Cells in Culture, Gene Expression and Application of Animal Cell Culture for Its Studies, Organ Culture, Transfection

UNIT - 4

Cell Fusion, Selectable Marker and Antibiotic Resistance, Hybridoma and Monoclonal Antibodies, Transplantation of Cultured Cell, Differentiation of Cells

UNIT - 5

Transgenesis and Transgenic Animals, Apoptosis, Necrosis, Senescence and Quiescence, Embryo Transfer Technology

COURSE OUTCOMES

Upon successful completion of the course, the students would be able to –

1. Understand the importance of cell line authentication and quality control to ensure the reliability of experimental results.
2. Understand the techniques for quantifying cell numbers and assessing cell viability in culture.
3. Use cultured cells to perform various assays, such as cell proliferation assays and enzyme activity assays.
4. Use cell cultures to screen for drug efficacy and toxicity
5. Create in vitro models of diseases to study pathogenesis and identify potential therapeutic targets.

Textbook Recommendations

1. Principles of Animal Cell Culture - Students Compendium, Basant Kumar Sinha and Rinesh Kumar M., International Book Distributing Co., First Edition, 2008
2. Freshney's Culture of Animal Cells A Manual of Basic Technique and Specialized Applications, Eighth Edition, Amanda Capes-Davis and R. Ian Freshney, Robert J. Geraghty and Raymond W. Nims, Wiley Blackwell, 2016
3. Introduction to Cell and Tissue Culture: Theory and Technique by Jennie P. Mather and Penelope E. Roberts

Reference Text Books

1. Tissue Culture Techniques: An Introduction by Paul F.A. Madson
2. Animal Cell Culture and Technology by Michael Butler and Kim Lee

BMST2512 **MOLECULAR DIAGNOSTICS** **L T P C**

4 0 0 4

Course Description

This course provides an in-depth exploration of the principles and applications of molecular diagnostics. Students will gain a comprehensive understanding of the techniques used in the detection and analysis of nucleic acids and proteins. The course will cover topics such as PCR, sequencing, microarrays, and the role of molecular diagnostics in personalized medicine, infectious disease, oncology, and genetic disorders. Laboratory sessions will offer hands-on experience with state-of-the-art diagnostic tools and techniques.

Course Objectives

1. Understand the Principles: To provide a thorough understanding of the principles underlying molecular diagnostics, including the chemistry and biology of nucleic acids and proteins.
2. Techniques and Technologies: To familiarize students with the various molecular diagnostic techniques such as PCR, sequencing, and microarrays.
3. Clinical Applications: To explore the clinical applications of molecular diagnostics in different fields such as oncology, infectious diseases, and genetic disorders.
4. Data Analysis: To teach students how to analyze and interpret data generated from molecular diagnostic tests.
5. Ethical and Regulatory Issues: To discuss the ethical, legal, and regulatory issues surrounding molecular diagnostics.

Unit I:

Introduction and History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. · Philosophy and general approach to clinical specimens, Sample collection- method of collection, transport and processing of samples, Interpretation of results, Normal microbial flora of the human body, Host - Parasite relationships.

Unit II:

Traditional disease diagnosis methods and tools - diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium., Diagnosis of fungal infections. Major fungal diseases: Dermatophytosis, Candidiasis and Aspergillosis. · Diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and · Retroviruses. · Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis. Study of helminthic diseases- Fasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis.

Unit III

Major Metabolic disorders and its causes. Traditional methods for the diagnosis of metabolic errors. Disease due to genetic disorders - Identifying human disease genes. Cancer- different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes. Methods available for the diagnosis of genetic diseases and metabolic disorders.

Unit IV:

Genetic disorders- Sickle cell anemia, Duchenne muscular Dystrophy, Retinoblastoma, Cystic Fibrosis and Sex – linked inherited disorders. · Neonatal and Prenatal disease diagnostics. Gender identification using amelogenin gene locus. Amplification of Y chromosome specific Short Tandem Repeats (Y-STR). Analysis of mitochondrial DNA for maternal inheritance.

Unit V:

Molecular diagnosis for early detection of cerebral palsy, Down syndrome etc. · Blood (formation, composition, function and pathology of blood disorders (haemoglobinopathies, sickle cell anemia, hemophilia), Muscle disorders (Duchene muscular dystrophy-DMD, Becker's muscular dystrophy-BMD, spinal muscular atrophy-SMA), Bone disorders (Osteogenesis imperfecta, Rheumatoid arthritis), Skin disorder (Albinism), Eye disorder (Retinitis pigmentosa

COURSE OUTCOMES

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

1. Explain Fundamental Concepts: Demonstrate a comprehensive understanding of the fundamental concepts in molecular diagnostics.
2. Perform Diagnostic Techniques: Perform and troubleshoot various molecular diagnostic techniques in a laboratory setting.
3. Analyze Diagnostic Data: Analyze and interpret data from molecular diagnostic tests, understanding their implications in a clinical context.
4. Apply Knowledge Clinically: Apply knowledge of molecular diagnostics to case studies and real-world clinical scenarios.
5. Evaluate Ethical Issues: Critically evaluate the ethical, legal, and regulatory issues associated with molecular diagnostics and propose solutions to potential challenges.

References

1. Medical Microbiology (1997), Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.

2. Parasitology (1997), Chatterjee K.D, Chatterjee Medical Publishers.

3. Bailey & Scott's Diagnostic Microbiology (2002), Betty A. Forbes , Daniel F. Sahm, Alice S. Weissfeld , Ernest A. Trevino, Published by C.V. Mosby

4. Jawetz, Melnick, & Adelberg's Medical Microbiology (2004), Geo F. Brooks, Stephen A. Morse, Janet S. Butel.

5. Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.

6. Henry's Clinical Diagnosis And Management By Laboratory Methods (2007) Mcpherson

7. Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws

8. Molecular Diagnostics for the Clinical Laboratorian 2Ed. 2006, W.B. Coleman. Humana Press.

9. Molecular Pathology in Clinical Practice (2007). D. G. B. Leonard.

10. Microbial Functional Genomics (2004) by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje. J.Wiley & Sons Publishers.

BMST2513 GENOMICS, PROTEOMICS AND COMPUTATIONAL DRUG DESIGN

L T P C

4 0 0 4

Course Description

This course delves into the comprehensive fields of genomics, proteomics, and computational drug design. Students will explore the structure, function, and interactions of genomes and proteomes, and how these biological insights can be leveraged to design and optimize new therapeutic drugs. The curriculum covers high-throughput techniques, bioinformatics tools, and computational methods that are essential for modern drug discovery. Hands-on laboratory sessions and computational workshops will provide practical experience in genomic and proteomic analyses, as well as in silico drug design.

Course Objectives

1. Foundational Knowledge: To provide students with a solid foundation in the principles of genomics and proteomics.
2. Technological Proficiency: To familiarize students with high-throughput technologies and bioinformatics tools used in genomics and proteomics research.
3. Computational Skills: To develop skills in computational methods for drug design, including molecular modeling and virtual screening.
4. Integration of Knowledge: To integrate genomic and proteomic data in the context of drug discovery and development.
5. Critical Analysis: To enhance the ability to critically analyze and interpret scientific literature and data in genomics, proteomics, and computational drug design.

Unit 1: Introduction

Genomics Overview, Importance of genomics, DNA Sequencing Techniques, Sanger sequencing, Next-generation sequencing (NGS), Genomic Databases, Proteomics overview, Role of proteomics in biology

Unit 2: Functional Genomics and Transcriptomics

Functional Genomics, Gene function annotation, RNA interference (RNAi, si RNA & mi-RNA), Transcriptomics, RNA-Seq analysis, microarray analysis, Gene Expression Data Analysis, Analyzing gene expression profiles, Data visualization and interpretation

Unit 3: Proteomics and Structural Biology

Mass Spectrometry in Proteomics, Principles of mass spectrometry, Protein identification and quantification, Techniques for protein quantification, Applications in disease research, Structural Biology Techniques, Determining protein structures, X-ray crystallography and NMR, Structure-Based Drug Design, Molecular docking and dynamics simulations

Unit 4: Computational Drug Design

Drug Discovery Overview, Stages of drug development, Role of computational methods, Virtual Screening and Ligand-Based Design, Pharmacophore modeling, Docking and virtual screening, Structure-Based Drug Design, Homology modeling, Rational drug design techniques, Drug ADMET Analysis, Absorption, distribution, metabolism, excretion, and toxicity, In silico toxicity prediction

Unit 5: Applications and Ethical Considerations

Personalized Medicine and Biotechnology, Genomics and personalized medicine, Case studies in biotechnology, Ethical and Legal Aspects, Ethical considerations in genomics and drug design, Intellectual property and regulatory issues, Future Trends and Course Conclusion, Emerging trends in genomics, proteomics, and drug design.

COURSE OUTCOMES

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

1. Understand Core Concepts: Demonstrate a comprehensive understanding of the core concepts in genomics, proteomics, and computational drug design.
2. Utilize Techniques: Employ high-throughput genomic and proteomic techniques, as well as bioinformatics tools, to analyze biological data.
3. Apply Computational Methods: Apply computational methods for drug design, including molecular modeling, docking, and virtual screening.

4. Interpret Data: Analyze and interpret complex genomic and proteomic data, integrating these findings into the drug discovery process.
5. Evaluate Scientific Literature: Critically evaluate scientific literature in the fields of genomics, proteomics, and computational drug design, and effectively communicate findings.

Textbooks:

1. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons
2. "Genomes" by T.A. Brown
3. "Principles of Proteomics" by Richard Twyman
4. "Proteomics: From Protein Sequence to Function" by S. Pennington and P. Dunn
5. "Principles of Computer-Aided Drug Discovery" by D. D. Suri and Michael K. Gilson

BMST2514 **BIOMEDICAL INSTRUMENTATION** **L T P C**

4 0 0 4

Course Description

The "Biomedical Instrumentation" course provides an in-depth exploration of the design, operation, and application of instruments used in the biomedical field. Students will learn about the principles and techniques underlying biomedical devices, including sensors, transducers, signal conditioning, data acquisition, and medical imaging systems. The course covers a range of biomedical instruments used in diagnostics, monitoring, and therapeutic applications. Through lectures, hands-on laboratory sessions, and project work, students will gain both theoretical knowledge and practical skills essential for developing and utilizing biomedical instrumentation in clinical and research settings.

Course Objectives

1. Understand Fundamental Principles: To provide a comprehensive understanding of the fundamental principles and technologies used in biomedical instrumentation.
2. Device Design and Function: To teach students the design, operation, and function of various biomedical devices and instruments.
3. Application in Healthcare: To explore the applications of biomedical instrumentation in diagnostics, monitoring, and therapeutic interventions.
4. Hands-on Experience: To offer practical experience in using and troubleshooting biomedical instruments through laboratory exercises and projects.
5. Evaluate Instrumentation: To develop skills in evaluating the performance, accuracy, and reliability of biomedical instruments and systems.

Unit -1

Introduction to Biomedical Instrumentation - Historical Perspective, Importance of Biomedical Instrumentation, Biological Signals and Noise

Introduction to Biological Signals

Sources of Noise in Biomedical Measurements

Electrodes and Amplifiers

Electrodes and Transducers

Bioelectric Amplifiers

Electrode and Amplifier Design
Blood Pressure and Flow Measurements

Unit - 2
Techniques for Blood Pressure Measurement
Blood Flow Measurement
Cardiac Measurements
Electrocardiography (ECG)
Cardiac Output Measurement
Pacemakers and Defibrillators
Respiration and Respiratory Measurements
Measurement of Respiratory Parameters
Spirometry and Gas Analysis
Neuromuscular and Nervous System Measurements

Unit - 3
Electromyography (EMG)
Electroencephalography (EEG)
Measurement of Nervous System Activity
Diagnostic Imaging
Radiography
Ultrasound
Magnetic Resonance Imaging (MRI)
Measurement of Body Temperature
Temperature Measurement Techniques
Biotelemetry and Telemedicine

Unit - 4
Remote Monitoring and Data Transmission
Patient Safety and Equipment
Medical Device Safety and Regulations
Clinical Laboratory Instrumentation
Analytical Methods and Instruments

Implantable Biomedical Devices
Overview of Implantable Devices

Unit - 5
Biomedical Data Acquisition Systems
Data Acquisition and Signal Processing
Biomedical Signal Processing
Digital Signal Processing in Biomedical Applications
Medical Imaging and Image Processing
Medical Image Processing Techniques
Healthcare Information Technology
Electronic Health Records (EHR) and Health Informatics
Emerging Trends and Future Directions
Advancements in Biomedical Instrumentation

COURSE OUTCOMES

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

1. Explain Instrumentation Principles: Demonstrate a thorough understanding of the basic principles and technologies underlying biomedical instrumentation.
2. Design and Operate Devices: Design, operate, and troubleshoot various biomedical instruments, understanding their components and functions.
3. Apply Instruments in Healthcare: Apply biomedical instruments to real-world healthcare problems, improving patient diagnostics, monitoring, and treatment.
4. Conduct Experiments: Perform experiments using biomedical instruments, accurately measuring and analyzing physiological signals.
5. Assess Device Performance: Critically evaluate the performance, accuracy, and reliability of biomedical instruments, and propose improvements for better clinical outcomes.

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi,2007.
2. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

3. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2 Edition,
2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, NewYork, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.

BMSL2506 GENOMICS AND PROTEOMICS LAB

L T P C

0 0 4 2

1. Comparative analysis of genomes from different organisms to identify similarities and differences.
2. Analysis of genomic data, including sequence alignment, gene prediction, and functional annotation.
3. Study of gene function, including knockdown and knockout experiments.
4. Techniques for studying protein structure, such as X-ray crystallography and NMR spectroscopy.
5. Comparative analysis of proteomes in different conditions or tissues.
6. Data analysis and interpretation using proteomics software and databases.
7. Integration of proteomic and metabolomic data to study metabolic pathways and their regulation.
8. Computational prediction of protein structures and modeling of protein-protein interactions.
9. Integration of proteomic and metabolomic data to study metabolic pathways and their regulation
10. Visualization of proteomic data using tools like Cytoscape and heatmaps for data exploration and presentation.

BMSL2506 MEDICAL INSTRUMENTATION LAB

L T P C

0 0 4 2

1. Familiarization with basic medical devices, such as thermometers, stethoscopes, and blood pressure cuffs.
2. Measuring and recording vital signs like heart rate, blood pressure, respiratory rate, and body temperature using appropriate medical instruments.
3. Setting up and performing ECG measurements on a test subject to understand the principles of electrocardiography.
4. Using pulse oximeters to measure oxygen saturation in the blood and heart rate.
5. Conducting spirometry tests to measure lung function and capacity.
6. Practicing the proper technique for taking blood pressure using sphygmomanometers and electronic blood pressure monitors.
7. Using software or phantoms to simulate medical imaging techniques like X-rays, ultrasounds, and CT scans.
8. Learning how to set up and administer intravenous fluids through IV lines.
9. Performing common laboratory tasks like sample collection, centrifugation, and analysis.
10. Calibrating medical devices to ensure accuracy and reliability.

Electromyography (EMG) Experiment:

11. Conducting experiments to measure muscle activity using EMG equipment.

BMST3515: TOOLS IN BIOINFORMATICS **L T P C**

4 0 0 4

Course Description:

This course introduces the interdisciplinary field of bioinformatics, focusing on the computational analysis of biological data. Students will learn fundamental concepts, techniques, and tools used to analyze biological sequences, genomes, and omics data. Topics covered include sequence alignment, genome assembly, protein structure prediction, and omics data analysis. The entire course will allow students to apply bioinformatics tools to real biological data and gain proficiency in data analysis and interpretation.

Course Outcomes:

1. Understand the fundamental principles and applications of bioinformatics in modern biology.
2. Gain proficiency in accessing, retrieving, and analyzing biological data from public databases.
3. Develop skills in sequence analysis, including sequence alignment and similarity searching.
4. Learn genome analysis techniques, including genome assembly, gene prediction, and functional annotation.
5. Apply bioinformatics tools and methods to analyze omics data and gain insights into biological processes and systems.

Unit 1: Introduction to Bioinformatics

Overview of bioinformatics: Definition, scope, and applications, Historical perspective and evolution of bioinformatics, biological databases, biological sequence analysis: DNA, RNA, and protein sequences, sequence alignment and sequence similarity

Unit 2: Bioinformatics Tools for Sequence Analysis

Pairwise alignment, Needleman-Wunsch, Smith-Waterman, multiple sequence alignment, ClustalW, MUSCLE, BLAST (Basic Local Alignment Search Tool) and its variants, Hidden Markov Models (HMMs) in sequence analysis, Functional annotation, Gene Ontology (GO) terms

Unit 3: Genomics and Transcriptomics Tools

Genome assembly, Gene prediction algorithms: Genescan, GeneMark, RNA sequencing (RNA-Seq) analysis, Read alignment, quantification, differential expression analysis, Genome annotation databases, Ensembl, NCBI RefSeq

Unit 4: Proteomics

Protein structure prediction, Homology modeling, ab initio modeling, threading methods, Protein-protein interaction prediction and analysis, STRING, Cytoscape, Functional enrichment analysis, GO enrichment, pathway analysis, KEGG, Reactome

Unit 5: Advanced Topics in Bioinformatics

Next-generation sequencing (NGS) data analysis pipelines: Variant calling, ChIP-Seq analysis, methylation analysis, SRA data analysis using R programming, Emerging trends and challenges in bioinformatics research, Ethical considerations, and best practices in bioinformatics research

COURSE OUTCOMES

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

1. Proficient Use of Bioinformatics Tools: Demonstrate proficiency in using a variety of bioinformatics tools and software for analyzing biological data, such as sequence alignment, genome annotation, and protein structure prediction.
2. Data Analysis and Interpretation: Analyze and interpret large-scale biological datasets, including genomic, transcriptomic, and proteomic data, using bioinformatics methodologies.
3. Problem-Solving Skills: Apply bioinformatics tools to solve real-world biological problems, such as identifying genetic variations associated with diseases, understanding gene expression patterns, and predicting protein functions.
4. Data Integration and Management: Integrate and manage diverse types of biological data from multiple sources, utilizing databases and computational frameworks to organize and retrieve information effectively.
5. Critical Evaluation of Tools and Methods: Critically evaluate the strengths and limitations of different bioinformatics tools and methods, and choose the appropriate tools for specific research questions or projects.

Textbooks and reference books:

- "Introduction to Bioinformatics" by Arthur M. Lesk

- "Bioinformatics: Sequence and Genome Analysis" by David W. Mount
- "Bioinformatics and Functional Genomics" by Jonathan Pevsner
- "Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R" by Röbbe Wünschiers

BMST3516 STEM CELLS AND CANCER

L	T	P	C
4	0	0	4

Course Description

The "Stem Cells and Cancer" course provides an in-depth understanding of the biology of stem cells and their role in cancer development and therapy. Students will explore the fundamental properties of stem cells, the mechanisms of stem cell self-renewal and differentiation, and the concept of the cancer stem cell. The course also covers the latest research in stem cell-based therapies and the challenges in targeting cancer stem cells. Through lectures, discussions, and hands-on laboratory sessions, students will gain both theoretical knowledge and practical skills in stem cell research and cancer biology.

Course Objectives

1. Fundamental Knowledge: To provide a comprehensive understanding of the basic biology of stem cells and their role in normal development and cancer.
2. Cancer Stem Cells: To explore the concept of cancer stem cells and their implications for cancer initiation, progression, and resistance to therapy.
3. Research Techniques: To familiarize students with the experimental techniques used in stem cell and cancer research, including cell culture, molecular biology, and imaging methods.
4. Therapeutic Applications: To examine the current and potential therapeutic applications of stem cells in regenerative medicine and cancer treatment.
5. Critical Analysis: To develop the ability to critically analyze and interpret scientific literature and experimental data in the fields of stem cell biology and cancer research.

UNIT 1

Introduction to Stem cells, Stem Cell Classification, Unique Properties of Stem Cells, Embryogenesis, In Vitro Fertilization, Somatic Stem Cells, Adult Stem Cell Plasticity, Haemopoietic Stem Cell, Laboratory evidence for embryonic and adult stem cells

UNIT II

Tissue engineering triad, Applications of Tissue Engineering, Gene Therapy, Production of Transgenic Animals using Virus as a Vector,

UNIT III

Cancer: A Historic Perspective, Cell Biology of Cancer, Cell Cycle check points of Cancer, Proto-oncogenes, Tumor Suppressor Genes; Telomere, Telomerase and Cancer; Cancer Risk factors; Cancer Classification; Cancer Diagnosis; Cancer staging

UNIT IV

Tumor Microenvironment, Signalling Receptors and Molecules in Cancer, Basics of PI3K-Akt and Ras-ERK Pathways, Cancer signalling pathways in Cell proliferation, survival, metabolism, migration and differentiation, Formation of Metastases, Routes of Metastasis, Barriers to Metastasis.

UNIT V

Six Hallmarks of Cancer, Cancer Treatment – Radiotherapy, Chemotherapy, Targeted therapy, Immunotherapy, Cell Therapy, Hormone Therapy Gene Therapy,

COURSE OUTCOMES

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

1. Explain Stem Cell Biology: Demonstrate a thorough understanding of the fundamental properties of stem cells, including their self-renewal and differentiation capabilities.
2. Understand Cancer Stem Cells: Explain the concept of cancer stem cells and describe their role in tumor initiation, progression, and therapeutic resistance.
3. Perform Research Techniques: Apply key experimental techniques used in stem cell and cancer research, such as cell culture, molecular assays, and imaging technologies.
4. Evaluate Therapeutic Approaches: Critically evaluate current and emerging stem cell-based therapies and their potential applications in regenerative medicine and cancer treatment.

5. Interpret Scientific Data: Analyze and interpret scientific literature and experimental data, effectively communicating findings in both written and oral formats.

Text Books:

1. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,

2. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press

3. The Biology of Cancer, Robert A. Weinberg, 2nd Edition, Taylor and Francis Publishers, 2013

4. Introduction to the cellular and molecular biology of cancer / Margaret A. Knowles, Peter J. Selby.Oxford University Press 2005, Fourth Edition

BMST3517 APPLICATIONS OF BIOTECHNOLOGY

L	T	P	C
4	0	0	4

Course Description

The "Applications of Biotechnology" course explores the diverse applications of biotechnology across various industries, including agriculture, medicine, environmental science, and industrial processes. Students will gain an understanding of the fundamental principles of biotechnology and how they are applied to develop innovative solutions to real-world problems. The course covers topics such as genetic engineering, bioprocessing, bioinformatics, and the ethical and regulatory issues surrounding biotechnological advancements. Through lectures, case studies, and hands-on laboratory exercises, students will learn to apply biotechnological techniques and tools in practical settings.

Course Objectives

1. Foundational Knowledge: To provide a comprehensive understanding of the fundamental principles and techniques of biotechnology.
2. Industrial Applications: To explore the diverse applications of biotechnology in various industries, including agriculture, medicine, environmental science, and industrial biotechnology.
3. Hands-on Experience: To offer practical experience with biotechnological tools and techniques through laboratory exercises and case studies.
4. Innovation and Problem-Solving: To develop skills in applying biotechnological approaches to solve real-world problems and innovate new products and processes.
5. Ethical and Regulatory Awareness: To discuss the ethical, legal, and regulatory issues associated with biotechnology and its applications.

Unit I: Introduction to Biotechnology: "Biotechnology: Old and New

What is biotechnology. Biotechnology stages: ancient, classical, and modern. "From DNA to Proteins: Structure of DNA and RNA. Central Dogma of Molecular Biology (Replication, Transcription & Translation). "Recombinant DNA Technology: Basic steps in

recombinant DNA technology, Restriction endonuclease, Cloning vector. Types of cloning, Gene transfer methods.

Unit II: Animal Biotechnology: Principles of transgenesis, different methods of gene transfer, Transgenic methodology, Animal cloning, Applications of transgenesis, Somatic cell nuclear transfer in humans; Pronuclear early embryonic development. Nuclear transfer technology: Transfer of nuclei into eggs; development potential of transplanted nuclei; reprogramming a nucleus. Development of transgenic mice and other animal models: by injection of foreign DNA/gene into zygote; optimization of construct for in vivo expression. Generation of chimeric, transgenic, and knockout mice and other animals and their characterization. Potential application of transgenic animals: Models for various diseases/disorders,

Unit III: Industrial and Microbial Biotechnology: Microbial growth and metabolic load, Types of fermenters, Fermentation process, Microbial metabolites. Active and passive immunization; Live, killed, attenuated, subunit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies.

Unit IV: Marine Biotechnology: definition, Primary research area in marine biotechnology, Transgenic fish, fluorescent fish pets. Production of peptides and proteins of biopharmaceutical interest (molecular pharming), Transgenic fishes, Transgenic poultry and Transgenic insects as bioreactors.

Unit V: Environmental biotechnology: Definition, principles and scope of ecology, evolution, origin of life and specification, Ecosystem structure and functions, abiotic and biotic component, The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradation of xenobiotics; Vermicomposting. Heavy metal pollution; Bioremediation of metal contaminated soils, spilled oil and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants. Microorganisms and organic pollutants; Extremophiles. Fermentation technology (Bioreactors).

COURSE OUTCOMES

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

1. Understand Biotechnological Principles: Demonstrate a thorough understanding of the fundamental principles and techniques used in biotechnology.
2. Apply Biotechnology in Various Industries: Apply biotechnological techniques and tools in diverse fields such as agriculture, medicine, environmental science, and industrial processes.
3. Perform Laboratory Techniques: Perform key biotechnological techniques, including genetic engineering, bioprocessing, and bioinformatics, in a laboratory setting.
4. Innovate Solutions: Develop innovative solutions to real-world problems using biotechnological approaches, demonstrating creativity and problem-solving skills.
5. Evaluate Ethical and Regulatory Issues: Critically evaluate the ethical, legal, and regulatory issues associated with biotechnological advancements and propose strategies to address these challenges.

Textbooks

1. Barnum, S. R. (2005). Biotechnology: An Introduction (Second). Thomson/Brooks/Cole. ISBN No. 0495112054.
2. Smith, J. E. (2009). Biotechnology (fifth). Cambridge University Press. ISBN No. 9781139476805.

BMST3603 RSEARCH METHODOLOGY

L	T	P	C
4	0	0	4

Course Description

The "Research Methodology" course is designed to provide students with a comprehensive understanding of the methods and techniques used in scientific research. This course covers the fundamental principles of research design, data collection, data analysis, and interpretation. Students will learn about various research methodologies, including qualitative, quantitative, and mixed methods, and will be equipped with the skills necessary to develop and conduct independent research projects. The course also emphasizes the ethical considerations and best practices in research. Through lectures, case studies, and practical exercises, students will gain hands-on experience in designing and implementing research studies.

Course Objectives

1. Understanding Research Principles: To provide a thorough understanding of the fundamental principles and concepts of research methodology.
2. Research Design: To teach students how to design effective research studies, including selecting appropriate methodologies and developing research questions and hypotheses.
3. Data Collection Techniques: To familiarize students with various data collection techniques, including surveys, experiments, observations, and interviews.
4. Data Analysis Skills: To develop students' skills in analyzing and interpreting research data using appropriate statistical and analytical tools.
5. Ethical Research Practices: To emphasize the importance of ethical considerations and best practices in conducting research.

Unit I Introduction to research and Formulating research problem

What is research? Types of research, why do we conduct research? How to turn a project into a business? Ethics in science including plagiarism and animal/ human testing and anonymity.

The importance of research problem formulation, your title: What does it reflect? How to define the objectives of your research? Constructing hypothesis, collecting data using primary sources, collecting data using secondary sources

Unit II Writing a scientific report.

Structure and components of a scientific report, Introduction, and literature review, what is a research introduction? Developing an outline, Reviewing the literature, How to invest the different resources available for students including textbooks, Google scholar and library, Selecting Methods for data collection, Differences in the methods of data collection in quantitative and qualitative research. Major approaches to information gathering.

Unit III Sample selection

The differences between sampling in quantitative and qualitative research, Sampling in quantitative research, Sampling in qualitative research, Processing and displaying data Processing data in quantitative and qualitative studies (editing and coding), The role of statistics in Research, Displaying analysed data (text, tables, and graphs)

Unit IV Discussion

Summation of the results, Comparison of data with the existing data, combining of data with the existing data Finding Empirical rules, linking results to the results of others, Conclusion and abstract, Summary of the study, summarizing findings in relation to the literature Surprises: Limitations and unexpected results, Implications of the study, Recommendations for further work, Concluding remarks, Abstract

Unit V

Introduction to biostatistics, Frequency distribution, central tendency, variability, Graphical representation, probability, vital statistics, regression, and correlation.

COURSE OUTCOMES

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

1. Comprehend Research Concepts: Demonstrate a comprehensive understanding of key concepts and principles in research methodology.
2. Design Research Studies: Design effective research studies, including formulating research questions, hypotheses, and selecting appropriate methodologies.
3. Collect and Analyze Data: Utilize various data collection techniques and analyze research data using appropriate statistical and analytical methods.
4. Interpret Research Findings: Interpret and critically evaluate research findings, understanding their implications and limitations.
5. Adhere to Ethical Standards: Conduct research ethically, adhering to best practices and recognizing the ethical considerations involved in scientific research.

Textbooks/Reference material

1. Kumar, R., 2011. Research methodology: A step-by-step guide for beginners. Sage.
2. Bryman, A., 2012. Social research methods. Oxford university press.
3. Katz, M., 2009. From research to manuscript. New York: Springer.
4. Roberts, C. and Hyatt, L., n.d. The dissertation journey.

BMST3603 ARTIFICIAL INTELLIGENCE (AI) IN HEALTHCARE

L	T	P	C
3	0	0	3

Course Description

The "Artificial Intelligence (AI) in Healthcare" course explores the transformative impact of AI technologies on the healthcare industry. Students will gain an understanding of the fundamental concepts of AI and how these technologies are applied to improve patient care, enhance medical research, and streamline healthcare operations. Topics include machine learning, natural language processing, medical imaging, predictive analytics, and personalized medicine. The course also addresses the ethical and regulatory challenges associated with implementing AI in healthcare. Through lectures, case studies, and hands-on projects, students will develop the skills necessary to leverage AI tools and techniques in a healthcare setting.

Course Objectives

1. Understand AI Concepts: To provide a comprehensive understanding of the fundamental concepts and technologies underpinning artificial intelligence.
2. Explore Healthcare Applications: To examine the diverse applications of AI in healthcare, including diagnostics, treatment planning, patient monitoring, and healthcare administration.
3. Develop Technical Skills: To equip students with practical skills in AI techniques such as machine learning, natural language processing, and data analytics.
4. Evaluate AI Solutions: To critically assess the effectiveness, efficiency, and safety of AI solutions in various healthcare contexts.
5. Ethical and Regulatory Awareness: To discuss the ethical, legal, and regulatory issues associated with the deployment of AI in healthcare.

Unit 1: Introduction to AI and Health care

• Overview of AI and its subset fields
• Importance of AI in Health care
• Fundamentals of Machine Learning
• Current trends and future directions
• Introduction to Generative AI

Unit 2: Advanced AI Techniques and Applications

- Deep Learning and Neural Networks
- Natural Language Processing (NLP) in Health care
- Image Analysis in Health care
- Applications of AI in Health care

Unit 3: Ethical and Societal Implications of AI in Health care

- Data privacy and security
- Bias and fairness
- Accountability and transparency

Unit 4: Public Health and Mental Health Applications

- Surveillance and outbreak prediction
- Contact tracing
- Vaccine development
- Depression and anxiety detection
- Suicide prevention
- Therapy and counselling
- Generative AI in Public Health and Mental Health

Unit 5: AI in Medical Imaging, Nursing, and Care

- Radiology
- Pathology
- Dermatology
- Predicting patient deterioration
- Tele-nursing
- Robot-assisted surgery
- Generative AI in Medical Imaging, Nursing, and Care

COURSE OUTCOMES

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

1. Explain AI Fundamentals: Demonstrate a thorough understanding of the core principles and technologies of artificial intelligence.

2. Apply AI in Healthcare: Apply AI techniques to real-world healthcare problems, improving patient outcomes and operational efficiency.
3. Utilize AI Tools: Use AI tools and platforms to develop and implement AI-driven solutions in healthcare scenarios.
4. Analyze AI Impact: Analyze and interpret the impact of AI technologies on healthcare delivery and patient care, including benefits and potential risks.
5. Address Ethical Issues: Critically evaluate the ethical and regulatory considerations of using AI in healthcare, ensuring responsible and compliant AI implementation.

References:

• Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig

• Health Informatics: An Interprofessional Approach by Carter, B. D., & Furukawa, M. F. (2017). Health Informatics: An Interprofessional Approach. Springer Publishing Company.

• "A Brief Survey of Generative Models in Machine Learning and Their Applications" by Creswell, A., & Giannelos, G. (2018). A brief survey of generative models in machine learning and their applications. IEEE Signal Processing Magazine, 35(1), 53-64.

Guidelines for Mini-project

Systematic reviews of literature serve various purposes and have numerous applications across different fields. Here are some common uses:

1. Systematic reviews play a crucial role in evidence-based research by providing scientists with synthesized, high-quality evidence to inform the most effective practices, interventions, and diagnostic approaches
2. Systematic reviews help identify gaps, inconsistencies, and areas of uncertainty in the existing literature, which can inform the development of research agendas and priorities. Researchers use systematic reviews to identify research questions, design studies, and allocate resources effectively.
3. Systematic reviews provide a foundation for meta-analysis, which statistically combines data from multiple studies to generate summary estimates of treatment effects or associations. Meta-analytic techniques enhance the precision and generalizability of findings and provide quantitative evidence to support conclusions.
4. Systematic reviews serve as valuable educational resources for research professionals, students, and industry experts. They provide comprehensive summaries of the current state of knowledge on specific topics, helping individuals stay up-to-date with the latest evidence and developments in their field.
5. Systematic reviews are increasingly used in social sciences and humanities disciplines to synthesize evidence on complex social phenomena, interventions, policies, and programs. They help researchers and policymakers make informed decisions and address pressing societal challenges.

The objectives and outcomes of a systematic review of literature in Mini-Project are centered around synthesizing existing evidence to answer a specific research question or address a particular topic comprehensively.

Objectives:

1. The primary objective of a systematic review is to systematically search and identify all relevant studies that address the research question or topic of interest. This ensures that the review is comprehensive and minimizes the risk of bias in study selection.
2. To assess the quality of included studies using predetermined criteria or tools. This involves critically appraising the methodological rigor, validity, and reliability of each study to determine its trustworthiness and relevance to the review's objectives.
3. To synthesize the findings of individual studies to provide a coherent and comprehensive summary of the existing evidence on the research question or topic. This involves analyzing and integrating data from multiple studies to identify patterns, trends, and inconsistencies across the literature.

Outcomes:

1. The primary outcome of a systematic review is evidence-based conclusions that summarize the current state of knowledge on the research question or topic. These conclusions are based on the synthesis and interpretation of high-quality evidence from multiple studies.
2. Systematic reviews may identify best practices, interventions, or strategies based on the synthesis of evidence from multiple studies. This can inform the development of guidelines, protocols, or interventions aimed at improving outcomes in clinical practice or public health.
3. Systematic reviews contribute to setting research agendas by identifying gaps, inconsistencies, or methodological issues in the existing literature. This helps prioritize future research efforts and investments in areas where evidence is lacking or additional research is needed.
4. Systematic reviews facilitate the translation and dissemination of research findings to relevant stakeholders, including healthcare professionals, policymakers, researchers, and the public.

5. Systematic reviews help bridge the gap between research evidence and practice by making evidence more accessible and understandable.

Process of Systematic Review of Literature

The students and Supervisor will list the topic of the Mini Project, which may help to determine the milestones related to final semester project work.

1) Formulate research question

• Define primary and secondary objectives

• Determine breadth of question

2) Identify relevant literature

• Systematic search

• Screen studies and determine eligibility

3) Extract and consolidate study-level data

• Extract data from relevant studies

• Collect relevant study-level characteristics and experimental covariates

4) Data Synthesis

• Interpret findings

• Evaluate the study consistency

• Pool data and summarize study-level data into meaning information

• Provide recommendations for future work

5) Report writing

• Write the report clearly, concisely, and effectively.

The evaluation is divided into two parts

1. Evaluation by Research Supervisor – 50 Marks

Component	Criteria	Excellent (91-100)	Good (81-90)	Fair (71-80)	Needs Improvement (61-70)	Inadequate (less than 60)
A (1 credit)	**Research Question/ Objective**	Clearly defined, focused, and relevant to the topic.	Well-defined and relevant to the topic.	Somewhat clear and relevant to the topic.	Unclear or irrelevant research question.	Missing or irrelevant research question.
B (1 credit)	**Data Extraction**	Systematic and comprehensive data extraction process with clear methods.	Systematic data extraction process with clear methods.	Adequate data extraction process with some gaps.	Incomplete or inconsistent data extraction process.	Missing or significantly flawed data extraction.
C (1 credit)	**Report Writing**	Demonstrates originality in research question, methodology, or interpretation of results.	Makes a meaningful contribution to the field.	Makes a basic contribution to the field.	Contribution to the field is limited or unclear.	No discernible contribution to the field.
D (1 credit)	**Regularity**	Reports to the guide regularly and consistent in work	Reports to the guide only once a week but consistent to the work	Reports to the guide only once a week	Irregular but communicates to the guide	Very irregular and do not communicate the guide
E (2 credits)	**Comprehensive Viva 100 Questions 100 Marks**					

2. Evaluation by Department Evaluation Committee (DEC) – 50 marks

S. No	Date(s) of review	Time in days	Activity	Marks allotted
1	10th May 2024	16 days	Area / Topic selection of mini-project	10 Marks
2	19th and 20th July 2024	34 Days (excluding Summer Vacation)	Mid-term Project Evaluation	15 Marks
3	18th and 19th October 2024	70 days	End-term project Evaluation	25 Marks

$$\text{TOTAL MARKS} = \frac{\sum(\text{marks of all components A to G}) + (\text{marks of component H} \times 2)}{6}$$

MAJOR PROJECT GUIDELINES

Objective: The objective of the major project is to enable students to conduct original research in biomedical genetics, addressing a specific research question or hypothesis using genetic approaches.

Project Overview: Students will work individually or in small groups to complete the following tasks:

1. **Literature Review:** Students will conduct a comprehensive literature review to identify a gap or research question in biomedical genetics. This involves reviewing relevant scientific articles, research papers, and databases to understand the current state of knowledge in the field.
2. **Research Question/Hypothesis:** Based on the literature review, students will formulate a specific research question or hypothesis to investigate. The research question should address an important problem or gap in biomedical genetics and be feasible to address within the scope of the project.
3. **Experimental Design:** Students will design experiments or computational analyses to address the research question or test the hypothesis. This may involve experimental techniques such as PCR, sequencing, gene expression analysis, genome editing, or computational methods such as bioinformatics, statistical analysis, or machine learning.
4. **Data Collection and Analysis:** Students will collect data through experiments or computational analyses and analyze the results. This includes data preprocessing, statistical analysis, interpretation of results, and visualization of findings.
5. **Results Interpretation:** Students will interpret the results of their analysis in the context of the research question or hypothesis. This involves identifying patterns, correlations, or associations in the data and discussing their implications for biomedical genetics.
6. **Discussion and Conclusion:** Students will discuss their findings in relation to existing literature, highlighting the significance of their results and any limitations of the study. They will also draw conclusions based on their findings and propose future directions for research in the field.
7. **Project Report:** Students will write a comprehensive project report documenting their research methodology, results, interpretation, and conclusions. The report

should follow a scientific format, including an introduction, methods, results, discussion, and conclusion sections.

8. **Presentation:** Students will deliver a final presentation of their project to the class or a panel of judges. The presentation should summarize the key findings of the project and highlight the significance of the research in the context of biomedical genetics.

Evaluation Criteria: Projects will be evaluated based on the following criteria:

1. **Research Question/Hypothesis:** Clarity, significance, and feasibility of the research question or hypothesis.
2. **Experimental Design:** Appropriateness and rigor of experimental or computational methods used.
3. **Data Collection and Analysis:** Effectiveness of data collection, preprocessing, analysis, and interpretation.
4. **Results Interpretation:** Depth and insightfulness of results interpretation in relation to the research question.
5. **Discussion and Conclusion:** Clarity, coherence, and significance of the discussion and conclusions drawn from the findings.
6. **Project Report:** Quality of written report, including organization, clarity, and adherence to scientific format.
7. **Presentation:** Clarity, organization, and effectiveness of the oral presentation, including visual aids and communication skills.

Resources: Provide students with access to relevant resources, including scientific literature, databases, experimental materials, computational tools, and guidance from faculty or mentors in the field of biomedical genetics.

Timeline: Outline a timeline for the major project, including deadlines for literature review, research question formulation, experimental design, data collection and analysis, report writing, and presentation.

Certainly! Here's a rubric tailored for evaluating major projects in biomedical genetics:

Major Project Rubric: Biomedical Genetics

Criteria	Excellent (5)	Good (4)	Fair (3)	Needs Improvement (2)	Inadequate (1)
Research Question/Hypothesis	Clearly defined and significant research question or hypothesis that addresses a gap in biomedical genetics.	Well-defined research question or hypothesis with relevance to biomedical genetics.	Research question or hypothesis is defined but lacks clarity or significance.	Research question or hypothesis is vague or irrelevant to biomedical genetics.	No clear research question or hypothesis provided.
Experimental Design	Rigorous and well-designed experimental or computational methods that effectively address the research question.	Experimental or computational methods are appropriate and adequately designed.	Experimental or computational methods are somewhat appropriate but may have some flaws or limitations.	Experimental or computational methods are inappropriate or poorly designed.	No evidence of experimental or computational design.
Data Collection and Analysis	Comprehensive data collection and analysis conducted with rigor and	Data collection and analysis are conducted effectively	Data collection and analysis are somewhat effective but may have	Data collection and analysis are ineffective or incomplete.	No evidence of data collection or analysis.

Criteria	Excellent (5)	Good (4)	Fair (3)	Needs Improvement (2)	Inadequate (1)
	attention to detail.	with minor issues.	some errors or limitations.		
Results Interpretation	Results are interpreted clearly and insightfully, demonstrating a deep understanding of genetic mechanisms.	Results are interpreted clearly, demonstrating understanding of genetic mechanisms.	Results interpretation is somewhat clear but may lack depth or insight.	Results interpretation is unclear or lacks relevance to genetic mechanisms.	No evidence of results interpretation.
Discussion and Conclusion	Discussion and conclusions are well-supported by the results and provide meaningful insights into genetic mechanisms.	Discussion and conclusions are supported by the results and provide relevant insights into genetic mechanisms.	Discussion and conclusions are somewhat supported by the results but may lack depth or relevance.	Discussion and conclusions are unclear or lack relevance to genetic mechanisms.	No evidence of discussion or conclusion.
Project Report	Project report is well-written, organized, and comprehensive, following a	Project report is well-written and organized,	Project report is adequately written but may lack	Project report is poorly written or lacks	No project report provided.

Criteria	Excellent (5)	Good (4)	Fair (3)	Needs Improvement (2)	Inadequate (1)
	scientific format with appropriate detail.	with adequate detail provided.	organization or detail.	organization and detail.	
Presentation	Presentation effectively communicates key points, with clear organization, engaging visuals, and confident delivery.	Presentation communicates key points effectively but may lack some clarity or engagement.	Presentation communicates key points but lacks clarity or engagement.	Presentation lacks clarity, organization, or engagement.	No presentation provided.
Contribution to Knowledge	Project makes a significant contribution to the understanding of genetic mechanisms in biomedical research.	Project makes a meaningful contribution to the understanding of genetic mechanisms in biomedical research.	Project makes some contribution to the understanding of genetic mechanisms in biomedical research.	Project makes little or no contribution to the understanding of genetic mechanisms in biomedical research.	No evidence of contribution to knowledge.

Overall Score:

Score	Description
40 - 45	Exceptional
32 - 39	Good
24 - 31	Fair
16 - 23	Needs Improvement
0 - 15	Inadequate