DRAFT REGULATION FOR CHOICE BASED CREDIT SYSTEM (CBCS)

FOR MASTER OF SCIENCE (M.Sc.) PROGRAMME UNDER SRI GURU RAM DAS UNIVERSITY OF HEALTH SCIENCES, SRI AMRITSAR

Implemented from

Academic Session 2024-2025

Members of the Core Committee for preparing Draft Regulation for the Choice Based Credit System (CBCS)

Sr No.	Name & Designation	Role
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2.	Dr A.P. Singh, Dean, SGRDUHS	Member
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4.	Dr Pankaj Gupta, Controller of Examinations, SGRDUHS	Member
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6.	Dr Rajiv Choudry, Deputy Controller of Examinations, SGRDUHS	Member
7.	Dr Prabhjot Kaur Gill, Professor, Department of Genetics, SGRDIMSR	Member Secretary

CONTENT

DRAFT REGULATION FOR MASTER OF MEDICAL SCIENCES CBCS

M.Sc. DEGREE/ P.G. DIPLOMA/ P.G. CERTIFICATE UNDER SRI GURU RAM DAS UNIVERSITY OF HEALTH SCIENCES, SRI AMRITSAR

1. PREAMPLE

The National Education Policy (NEP) 2020, along with the University Grants Commission (UGC) guidelines, aims to bring significant reforms to postgraduate (PG) education in all disciplines, including medical sciences, through the implementation of the Choice Based Credit System (CBCS). This framework seeks to enhance the quality, flexibility, and interdisciplinary nature of M.Sc. programs, aligning them with global standards and promoting a student-centric approach. NEP 2020 proposes varied structures for PG programs, acknowledging the diversity in undergraduate education. The curriculum and credit framework for M.Sc. programs are aligned with the National Higher Education Qualifications Framework (NHEQF). Credits earned will be managed under the National Credit Framework (NCrF), facilitating credit transfer and accumulation. CBCS provides students with the flexibility to choose courses based on their interests and career goals. It encourages interdisciplinary learning, allowing students to select courses from within their discipline and potentially from other disciplines. Students with majors or minors in their UG program may be able to pursue PG studies in either, provided they demonstrate competence.

The framework supports multiple entry and exits options in M.Sc. programs through the Academic Bank of Credits (ABC), allowing students to accumulate credits and resume their studies after a break. The framework encourages the adoption of various learning modes, including offline, online, hybrid, and Open Distance Learning (ODL) methods, providing greater accessibility and flexibility. Emphasis will be on continuous and formative assessment strategies, along with rigorous plagiarism checks. A comprehensive grading system, often a 10-point scale, will be used to evaluate student performance. The Academic Bank of Credits (ABC) facilitates the seamless transfer and accumulation of credit points, supporting both horizontal (across institutions) and vertical (across different levels of education) mobility within the higher education system. Flexibility to choose specialized elective courses within or related to their medical specialization. Implementation of a standardized grading system that aligns with UGC guidelines, facilitating better comparison of academic performance across institutions.

The introduction of CBCS for M.Sc. programs in medical sciences, as per NEP UGC guidelines, holds the potential to modernize medical education, enhance its flexibility, and promote interdisciplinary learning.

2. TITLE AND COMMENCEMENT

These Regulations shall be called the Sri Guru Ram Das University of Health Sciences regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Master of Science Degree Programmes. These Regulations shall be

applicable to all candidates admitted into the full-time M.Sc. programmes run under Sri Guru Ram Das University of Health Sciences, Sri Amritsar from the calendar year 2024.

3. OBJECTIVES:

Introduction of Choice Based Credit System has following objectives:

i. To make the course curriculum learner centric and encourage inter-disciplinary without disturbing the domain centric knowledge
ii. To promote mobility of students and help in optimizing learning
iii. To allow autonomy to the teachers with built in accountability.
iv. Continuous evaluation of students to help in optimizing learning
v. To introduce transparency in the evaluation system and improve employability among students

4. APPLICABILITY OF CBCS AND GRADING SYSTEM

The Regulation herein specified applies to all full-time M.Sc. Programmmes (Medical and Paramedical) under choice Based Credit System by the Sri Guru Ram Das University of Health Sciences herein after referred to as the University.

i. The Institute imparting M.Sc. teaching, hereinafter, shall be referred to as Institute (SGRDIMSR).
ii. The Regulations, herein specified, shall apply to full-time Post- Graduate Programmes offered by the Sri Guru Ram Das University of Health Sciences, hereinafter, referred to as the "University".
iii. The University Department/College/Institute imparting M.Sc. teaching, hereinafter, shall be referred to as the "Department /College/ Institute".

5. DURATION (TIME FRAME)

i. The M.Sc. programme for a regular student shall be for a period of two years to be completed in a maximum of 'Four Years' period from the date of admission/registration of the candidate.
ii. Each academic year shall comprise of two semesters, viz. Odd and Even semesters.
iii. Odd Semesters shall be from August to January and the Even Semester shall be from February to July.

6. CHOOSING PROGRAM STUDY COURSES

i. At the time of admission each student will identify a Degree/ Diploma/ Certificate Programme.
ii. Every programme will have core courses (Foundation, core and elective) as prescribed by the concerned M.Sc. Board of Studies and the Faculty.

7. ELIGIBILITY-FOR ADMISSION

i. The candidate seeking admission in M.Sc. programmes must have obtained at least 50% marks in the subject concerned at the Graduation/equivalent examinations.

ii. The M.Sc. Programme is open to a candidate who has passed Undergraduate degree in Medical Sciences (B.Sc. Medical Stream)/MBBS/BDS/BPT/BAMS or equivalent examination from a Statutory Institution/University.

OR

Any other examination recognized by the Board of Management of this University as an equivalent course/examination thereto, from time to time.

iii. The selection of the candidates shall be purely on Merit/Performance in the Centralised Entrance Test (CET) conducted by SGRDUHS

OR

The National Testing Agency conducted the CUET (PG).

iv. The Centralised Entrance Test shall be a Multiple choice questions examination of 2 hours duration of 50 marks.

v. The syllabus for M.Sc. test includes the syllabus of B.Sc. Medical Sciences as per the chosen specialization.

8. DEFINITIONS:

i. **Academic Year**: Two consecutive (one odd + one even) semesters constitute one academic year.

ii. **Academic Calendar**: An Academic Calendar will be prepared by the university to maintain uniformity in the CBCS of all M.Sc. Programmes, semesters and course in the college/institute run under the university.

iii. **Semester**: An academic year comprising 180 working days in the least is divided into two semesters, each semester having at least 90 working days. With six working days in a week this would mean that each semester will have 90 / 6 = 15 teaching/working weeks. Considering that each teaching day has 5 teaching/ working hours, a teaching week would have 5 x 6 = 30 working /teaching hours and each semester will have 30 x 15= 450 teaching hours available for each student. In nut shell, each semester will have 14 — 15 weeks of teaching and the remaining time of the semester will be utilized for examinations, evaluation and publication of the result. Each week will impart 30 hours of teaching spread over 6 days.

iv. The odd semester is scheduled from August to January and the even semester from February to July. Each week has a minimum 30 working hours spread over 6 days.

v. Each semester will include – Admission, Course work, conduct of examinations and declaration of result including semester break.

vi. **Choice Based Credit System (CBCS)**: CBCS provides choice for students to select from the prescribed Programme.

vii. **Programmes**:

   i. Programme: An educational programme leading to award of Master's degree, diploma or certificate.

ii. A Participant of the programme is a student who registered himself/herself with the University for any of the programmes and attend the same as per the schedule followed by the Department/Institute/College.

iii. Full-time programmes are those programmes in which the participants devote their full time in fulfilment of the academic schedule of the programme(s) and are not employed elsewhere.

viii. **Courses**:

a) Course is a structured set of instructions that are imparted to a student on the basis of a syllabus or a framework decided beforehand and has the sanction of the different academic (Board of Studies, Faculty, Academic Council) and executive (Senate/ Executive Council, Finance Committee) bodies of the University extended over a semester

b) Each course is designed variously under instructions given as Lectures, Tutorials, and Practical (laboratory and field exercises). Usually, these components are referred to as L, T, and P components. The credits for each course determine the volume of the course content. where L stands for Lecture session, T stands for Tutorial session consisting participatory discussion/self-study/desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes and P stands for Practice session and it consists of Hands-on experience/Laboratory Experiments/OPD-IPD Studies/ Case studies that equip students to acquire the much-required skill component.

c) **Foundation Courses (FC)**: The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. Compulsory Foundation courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at man-making education.

d) **Core Courses (CC)**: There may be Core Courses in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

A Core course may be a Soft Core if there is a choice or an option for the candidate to choose a course from a pool of courses from the main discipline/subject of study or from a related discipline/courses which supports the main discipline/courses. In contrast to the phrase Soft Core, a compulsory core course is called a Hard Core Course.

e) **Elective Course (EC):** This is a course which can be chosen from a pool of courses. It may be: Supportive to the discipline of study, Providing an expanded scope, Enabling an exposure to some other discipline/domain, Nurturing students' proficiency/skill.

Generic Elective course (GE): An elective may be "Generic Elective (GE)" focusing on those courses which add generic proficiency to the students.

Discipline Centric Course (DC): An elective may also be "Discipline Centric (DC)" or may be chosen from an unrelated discipline. It may be called an "Open Elective".

Skill Enhancement Course (SEC/AE): "Skill Enhancement (SE)" is leading to adding to the skill/ability enhancement specific to the programme.

ix. The BOS may add or delete courses in combination of programme.

x. Each PG Degree Programme shall be designed as 80 credits, full-time postgraduate programme delivered in Four (04) Semesters.

xi. **Credit**: The term 'credit' refers to the weightage given to a course, usually in terms of the number of instructional hours per week assigned to it. This explains why usually 'credit' is taken to mean 'credit hours'. The credits also determine the volume of course contents and delivery of programme such as lectures tutorials, practical, assignments etc. Credit: Credit stands for following in the context of CBCS. Term Credit has a connotation of achievement or earning through learning effort.

Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit shall mean one hour of teaching (lecture or tutorial) or two hours of laboratory /practical work per week in a semester of 16-18 weeks.

9. EVALUATION OF STUDENTS

i. Continued Internal Assessment has to be followed by giving at least four examinations, unannounced quiz, assignment, field work etc.

ii. Postgraduate Programme: Purely internal evaluation for courses and external evaluation for thesis/dissertation/project work.

10. EXAMINATION SCHEDULE

i. At least four examinations shall be held–First hourly examination (weightage 10%), Mid-term examination (weightage 25%), Second hourly examination (weightage 10%) and end semester examination (weightage not less than 50%) and 5% attendance weightage. The weightage for Continued Internal Assessment and the End Semester Examination will be equal

ii. The teacher may decide to give an assignment or a class seminar in lieu of the first or second hourly examination with intimation to Head of the Department.

iii. All postgraduate examinations will be held in the regular class and conducted by the class teacher under supervision of Head of the Department.

iv. All the teachers offering courses shall submit a midterm report to COE in a prescribed format within one week of holding the midterm examination.

v. All the examinations will be held during the week earmarked by the Registrar in the academic calendar.

11. ELIGIBILITY FOR APPEARING IN END SEMESTER EXAMINATION

i. 50% aggregate marks in First Hourly, Second Hourly and Mid Term Examination.

ii. 75% attendance in class lectures and practical classes.

iii. List of students detained in different courses to be displayed by the concerned Head of the Department well in advance of filling examination forms.

12. THESIS SUBMISSION GUIDELINES

i. After the allotment of Supervisor and Co-Supervisor in the first semester by the Competent Authority of the Institution (Director Principal, Registrar, Dean). Every candidate shall submit a thesis plan (synopsis) to the University within second semester from the date of admission.

ii. Every candidate shall carry out work on an approved research project under the guidance of a recognized PG Teacher (First preference given to Professor only or I. Teachers holding Ph.D. qualification having at least 3 years teaching experience after Ph.D. may be appointed as supervisor, II. After MD/MS 10 years of teaching and research experience). The teachers mentioned at [I and II] should also have at least 5 research papers in indexed National and International Journals.

iii. Thesis shall be submitted to the University before the commencement of the fourth semester Theory Examinations i.e. by March of the preceding year for July/August examinations.

iv. The Vice-Chancellor may allow a candidate to submit the thesis within one month after the date fixed for the purpose with the prescribed late fee.

v. The thesis shall embody the results of the candidate's own research and/or experience and shall contain precise reference to the publications quoted, and 'must attain a good standard and shall be satisfactory in literary presentation and in other respects and should end with a summary embodying conclusion arrived at by the candidate. The original thesis as well as the photocopies should be prepared on a high quality white paper of A4 size. All pages must have at least 4 cm margin on the left 1.5 cm on right and 2.5 cm on the top and bottom. The general text of the manuscript should be typed in 1.5 line space in Arial font, size 12 with one side printing of the paper. The text of the manuscript should be justified.

vi. After completion of all prescribed requirements of the programme, five hard bound copies of thesis using high quality Rexene (The colour of Rexene to be used for binding will be Navy Blue) with printing in golden letters on the front cover as well as on the spine shall be submitted for stamping by the Registrar. A soft copy of thesis on a CD will be submitted.

vii. The thesis shall be examined by a minimum of two examiners. One internal and one external examiner. Ordinarily, this examiner will not be appointed the External Examiner for theory and Clinical/Practical examination. The candidates who have submitted the thesis in University will be allowed to appear in the final examination. However, the result shall be declared only on receipt of the thesis acceptance from both the examiners.

viii. The internal examiner shall send only report to the University after evaluation of thesis and the evaluated copy will be deposited in the CoEs office. The external examiner shall also send copy of the thesis along with the report to the University. The University shall keep two copies of thesis in the University Library for reference of the students.

13. ACADEMIC QUALIFICATIONS AND APPOINTMENT OF EXTERNAL/INTERNAL EXAMINERS

i. M.D/Ph.D. as per specialization (Anatomy/Biochemistry/Microbiology /Pathology/Physiology/Genetics) with minimum one year of teaching/professional experience after Postgraduation in a teaching institution. OR

ii. M.Sc. Medical with minimum five years of teaching/professional experience of which at least 2 years after the post-graduate qualification in a teaching Institution.

iii. There shall be two examiners out of which one shall be external examiner recommended by Board of Studies and approved by Academic Council. The Board of Studies shall supply the panel of examiners to university for appointment of internal/external examiners by the Vice Chancellor.

14. EXAMINATIONS AND EVALUATION OF STUDENTS

i. In case a student could not appear in any component of the Continuous Internal Assessment of a course due to medical reasons or under other exceptional circumstances (supported by documentary evidence), a separate examination in that component will be arranged by the concerned teacher with the approval of respective HOD before the beginning of End Semester Examination.

ii. A student will be permitted to appear in the End-Semester Examination as per the Conduct of Examinations Rules after filling up the prescribed examination form, payment of the prescribed examination fee, satisfying the attendance requirement and fulfilling other eligibility criteria.

iii. The question paper pattern of the End Semester Examination will be prescribed by the concerned Board of Studies and at least two sets of question papers for these examinations will be submitted to COEs in the beginning of the semester, one of these sets will be passed on to the concerned HOD one hour before the Examination. It will be compulsory to pass the End Semester Examination for successful completion of the course.

iv. Unless prescribed in the Regulations and the Scheme of Examination of a particular programme, a candidate will be deemed to have completed his/her course successfully if he/she obtains minimum 50% marks/Grade point of 5.00/ as per the 10-point scale.

v. If a student fails in the End Semester Examination, a supplementary examination within six weeks of declaration of result will be arranged for such students by the respective department with the help of COEs. The marks for all other components as applicable will however, be carried forward in such cases. The students will be required to deposit the examination form along with prescribed fee for all such examinations.

vi. The marks obtained in the Continued Internal Assessment and all the examinations will be shown to the students. The evaluation scheme will also be explained to students.

vii. At the end of semester, the result for each course is compiled by the concerned teacher, discussed with the head of department and compiled result submitted by HOD to COE.

15. SUPPLEMENTARY EXAMINATIONS

i. If a student fails in the End Semester Examinations, a supplementary examination will be conducted with next semester examinations. The marks for all other components as applicable will however, be carried forward in such cases. Whereas shortfall in attendance will be covered by assignments or lecture attendance.

ii. Supplementary examination can be given for maximum of three courses (including practicals) or 50% courses (core & foundation courses).

iii. After declaration of result the Principal concerned shall display the list of students eligible to take supplementary examinations.

iv. The eligible students shall apply for the examination within three days of display of this list after paying the fee and filling the prescribed application form.

v. The students who fail to get pass marks shall have to register the course again and no more chance to appear in the supplementary examination shall be permitted until or unless some serious circumstances.

16. RE-EVALUATION

i. The re-evaluation is applicable only for final theory examinations conducted under External Examination System. If the student is eligible for supplementary examination, he/she can either opt for re-evaluation of the final paper or request for supplementary examination.

ii. Only one of these two options shall be considered by the Controller of Examinations. Once the student appears in the supplementary examination then only, the paper of supplementary examination can be considered for re-evaluation if desired by the student.

iii. The number of courses for re-evaluation in a semester can be availed up to 50% of the number of courses registered or three, whichever is less, even if a candidate has passed the course in the final examination while considering eligibility for re-evaluation, based on 50% of registered courses, the fraction of 0.5 and above will be rounded off upwards.

iv. The student may apply for re-evaluation with prescribed fee within fifteen working days of declaration of the result in a prescribed performa. The re-evaluation will be done by an examiner other than the one who has earlier marked the answer book. The re-evaluation result will be submitted to the Controller of Examinations through the teacher concerned for revision of the result, if need be.

17. GRADING SYSTEM:

A. Award of Grades and Credit points

i. Adopted the UGC recommended 10-point grading system of awarding grades and CGPA under ChoiceBased Credit Semester System.

ii. Grading of Performance Based on the performance, each student shall be awarded a final grade at the end of the semester for each course. Absolute grading is used by converting the marks to grade, based on predetermined class intervals.

iii. UGC 10 point grading system is used with pass grade modified.

Table 1: CBCS Grading System and Marks Equivalence

Percentage Marks	**Letter Grade**	**Grade Points**
>90 to ≤100	O (Outstanding)	**9.1-10**
>80 to 90	A+ (Excellent)	**8.1-9.0**
>70 to ≤80	A (Very Good)	**7.1-8.0**
>60 to ≤70	B+ (Good)	**6.1-7.0**
>50 to ≤60	B (Above Average)	**5.1-6.0**
>40 to ≤50	C (Average)	**4.1-5.0**
≥35 to ≤40	F (Fail)	**3.5-4.0**
Below 40	F (Fail)	**0**
Absent (Ab)	F (Fail)	**0**

For Medical/Paramedical Programme – Pass is at C Grade (5.0 grade point) 50% and above

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). SPGA is the weighted average of the grade points obtained in all courses by the student during the semester.

i. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination. Registrations of such students for the respective courses shall be treated as cancelled and the candidate has to re-register and repeat the course when it is offered next time.
ii. For non-credit courses 'Satisfactory' or 'Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

B. SGPA Computation

Course Number	Credits	Letter grade	Grade point	Credit point (Credit × grade)
1	3 (C1)	A	8 (G1)	3 × 8 = 24
2	4(C2)	B+	7(G2)	4 × 7 = 28
3	3(C3)	B	6(G3)	3 × 6 = 18

SGPA=	C1G1+C2G2+C3G3	70	=7
	C1+C2+C3	10	

Table 2. Illustration of Computation of SGPA and CGPA

Course	**Credit**	**GradeLetter**	**Grade Point**	**Credit Point (Credit x Grade)**
Course 1	3	A	8	3 X 8 = 24
Course 2	4	B+	7	4 X 7 = 28
Course 3	3	B	6	3 X 6 = 18
Course 4	3	O	10	3 X 10 = 30
Course 5	3	C	5	3 X 5 = 15
Course 6	4	B	6	4 X 6 = 24
	20			139
Illustration for SGPA **Thus, SGPA = 139/20 = 6.95**				

Table 3: Total SGPA

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 20 SGPA : 6.9	Credit : 22 SGPA : 6.8	Credit : 25 SGPA : 6.6	Credit : 26 SGPA : 6.0
Semester 5	**Semester 6**		
Credit : 26 SGPA : 6.3	Credit : 25 SGPA : 8.0		
Illustration for CGPA			

Thus,

CGPA =20 x 6.9 + 22 x 6.8 + 25 x 6.6 + 26 x 6.0 + 26 x 6.3 + 25 x 8.0/144

= 6.75/B+

C. Transcript:

Based on the above recommendations on Letter grades, grade points and SGPA and CGPA, the transcript for each semester and a consolidated transcript indicating the performance in all semesters may be issued.

D. Re-Entry after Break of Study:

i. The University regulations for readmission are applicable for a candidate seeking re-entry to a program.
ii. Students admitted the program and absenting for more than 3 months must seek readmission into the appropriate semester as per university norms.
iii. The student shall follow the syllabus in vogue (currently approved/is beingfollowed) for the program.
iv. All re-admissions of students are course to the approval of the Vice-Chancellor.
v. All dropped students with CGPA of less than 5.0 in PG programmes, have right to petition for readmission to first year class against vacant seats.
vi. The student shall apply to the Registrar within seven days of his/her dropping from the university.
vii. The case will be reviewed by a petition committee.
viii. Readmission shall be permitted only once.

E. Ranking

i. The first two ranks of the programme will be decided on the basis of grades of CGPA in the courses.
ii. In case of a tie, marks % of core courses only will be taken into account.

F. Normal, Maximum and Minimum Credit Load in a Semester

i. In a programme, the normal full-time programme of work in a semester shall be 24 credit hours.
ii. A maximum of 30 and a minimum of 18 credit hours may be taken by a student.
iii. The PG students on 'Good Standing' may be allowed to register a maximum of 34 credit hours (4 extra credit hours) during their semesters by the Dean, provided these courses registered have been offered on regular basis.

18. **PROGRAMME CONTINUATION / DISCONTINUATION**:

The continuation/discontinuation and Exit with Degree shall be governed as follows:

i. A candidate shall be allowed to continue the programme provided he/she maintains a CGPA of 5.0 both in all theory and lab courses at the end of the even semesters (e.g. 2^{nd}, 4^{th} for the academic programmes). Otherwise, the candidate shall remain in the same year till he/she maintains the required CGPA as 5.0.

ii. Further, if a student who has been detained due to shortage of attendance in more than 50% course in a semester and due to that he/she is not able to maintain minimum criteria of required CGPA 5.0, then such student will be detained in entire semester and shall have to attend regular classes of all courses in next academic year of said semester.

iii. A candidate shall have to re-appear in semester examinations of the courses with Fail/Absent grade (as per Grade Assignment Table), as and when the same course is offered during regular course of study. Such students shall retain their internal/sessional marks.

iv. Attendance requirement for appearing in End Semester Examination of each of the semesters shall be 75%.

v. A student who has been detained due to shortage of attendance shall not be allowed to be promoted to next semester and he/she will be required to repeat only those courses where the student could not make up required 75% attendance in a semester. That is, attendance of a student shall be considered course-wise and if any student fails to maintain minimum criteria of 75% attendance in a course, then he/she will be detained in that particular course only and all such students will have to reappear for that course(s) and also attend the class of that particular course with the next batch of students of said semester.

vi. Maximum three attempts including main exam (main exam + two backlogs) shall be provided to all students to clear his/her backlogs/arrear in order to get promoted in next year/semester. That is, maximum two academic years are permissible for a student for the completion of the academic programme/course. In no situation a student will be allowed to take more than two academic years, for any reason whatsoever, including for the reasons of detention for shortage of attendance or deficiency of CGPA during the whole term of completion of the course/programme.

vii. A student who has already availed two additional academic years to clear his/her backlogs/arrears in order to be eligible for the Degree in stipulated time period, will not get any further chance and therefore admission of such student(s) would be automatically stand cancelled.

19. CORRECTION OF ERRORS

In case of any error is detected in the marks recorded on the award list, the examiner(s) concerned shall make a request to correct the mistake to the Principal through the Head of the department, and shall attach relevant documentary evidence. A committee consisting of the following members shall take suitable remedial measures depending upon the merit of the case.

a) Dean/Principal (Chairman)
b) Head of the department.
c) Two Faculty Member nominated by the Dean

20. QUESTION PATTERN AND PAPER SETTING

i. At least two sets of question papers for the examinations will be submitted to COE in the beginning of the semester, one of these sets will be passed on to the concerned in-

charge one hour before the Examination. It will be compulsory to pass the End Semester Examination for successful completion of the course.

ii. Question Paper Pattern for End Term Examinations (100 Marks for 3 hours) includes- (a). Filling in the blanks 10 marks, (b) Multiple choice questions 10 marks., (c). Short notes 10x3=30 marks and (d). Essay type questions 10x5=50 marks

iii. Question Paper Pattern for End Term Examinations (50 Marks for 2 hours) includes- (a). Filling in the blanks 5 marks, (b). Multiple choice questions 5 marks, (c). Short notes 5x2=20 marks and (d). Essay type questions 3x10=30 marks.

iv. Similar pattern for first hourly, second hourly and Midterm/sendup examinations should be followed.

21. LIST OF ELECTIVES COURSES

Course code	Title	Credits
HVE.501	Human Values & Ethics (Value added course)	**03**
RMB.501	Research Methodology and Biostatistics	**03**
IPR.550	Bioethics & Intellectual Property Rights	**03**
BMW.575	Biomedical waste management	03
ACA.575	Advances in Cancer Biology	**03**
PGC.575	Principles of Medical Genetics	**03**
GEP.575	Genomics and Proteomics	**03**
RDT.575	Recombinant DNA Technology and Genetic Engineering	**03**

COURSE CODES			
Sr. No.	**Programme**	**Course code**	**Number code**
1.	MSc Human Anatomy	M.Sc.-ANT	5.1
2.	MSc Human Physiology	M.Sc.-PHY	5.2
3.	MSc Medical Biochemistry	M.Sc.-BIC	5.3
4.	MSc Medical Microbiology	M.Sc.-MIC	5.4
5.	MSc MLT Biochemistry	M.Sc.MLT-BIC	5.5
6.	MSc MLT Microbiology	M.Sc.MLT-MIC	5.6
7.	MSc MLT Histopathology	M.Sc.MLT-HIS	5.7

Postgraduate Level	Human Physiology	PHY.501 onwards PHY.601 onwards
	Human Anatomy	ANT. 501 onwards ANT. 601 onwards
	Biochemistry MLT Biochemistry	BIC.501 onwards MLTB.501 onwards
	Genetics	MGC.501 onwards
	Microbiology MLT Microbiology	MIC.501 onwards MLTM.501 onwards
	Histopathology	MLTHP.501 onwards
	Research Methodology and Biostatistics	RMB.501 RMB.601
	Seminar in respective discipline	599
	Masters Research in respective discipline	600
Advanced level Certified courses	Seminar in respective discipline	699
	Research in respective discipline	700

The candidate qualifying for the award of M.Sc. (Physiology) should be able to:

i. Demonstrate comprehensive understanding of physiology as well as that of the applied disciplines;
ii. Demonstrate adequate knowledge of the current developments in medical sciences as related to physiology
iii. Teach undergraduates and postgraduates in physiology
iv. Plan and conduct research;
v. Plan educational programs in physiology utilizing modern methods of teaching and evaluation; and Organize and equip physiology laboratories.

Objectives

i. Demonstrate comprehensive understanding of the structure, function and development of the human body as related to physiology.
ii. Demonstrate elementary understanding of the clinical applications of physiology,
iii. Critically evaluate the impact of the recent information on the genesis of current concepts related to various topics of physiology
iv. Recapitulate the information Imparted to the undergraduate students of physiology,
v. Perform and critically evaluate the practical exercises done by undergraduate students.
vi. Identify a research problem which could be basic, fundamental or applied in nature; define the objectives of the problem and give a fair assessment as to what is expected to be achieved at the completion of the project; design and carry out technical procedures required for the study; record accurately and systematically the observations and analyze them objectively: effectively use statistical methods for analyzing the data; interpret the observations in the light of existing knowledge and highlight in what way his observations have advanced scientific knowledge; write a scientific paper on the lines accepted by standard scientific journals;
vii. Design, fabricate and use indigenous gadgets for experimental purposes;
viii. Demonstrate familiarity with the principles of medical education including definitions of objectives, curriculum construction, merits and merits of various tools used in the teaching learning process: use of learning aids and learning settings, and methods of evaluation;
ix. Share learning experiences with the undergraduate and postgraduate students using appropriate pedagogical skills and methods;
x. Draw out meaningful curricula for teaching medical and paramedical courses; give lucid, interactive lectures, presenting the information in a logical, simple and comprehensive manner; generate interest and curiosity amongst the students during lectures; give practical demonstrations;
xi. Handle and order for stores, draw up lists of equipment required to equip physiology laboratories

Sri Guru Ram Das University of Health Sciences, Amritsar
Course Structure for the M.Sc. Physiology

Course code	Course Title	Course Type	L+T+P	Total Credits	Marks
Semester-I					
PHY.501	General & Cellular Physiology	Core Course	3+0+0	3	100
PHY.502	Nerve Muscular Physiology	Core Course	3+0+0	3	100
PHY.503	Hematology	Core course	3+0+0	3	100
PHY.504	Renal Physiology	Core course	3+0+0	3	50
HVE.501	Human Values and Ethics	Value added course	3+0+0	3	NC**
PHY.525	Practical (Haematology) in Physiology-I	Core course	0+0+3	3	100
PHY.550	Lab Rotation	Core course	0+0+3	3	-
PHY.599	Seminar-I/Journal Club	Core course	2+0+0	2	50
		Total Credits	**17+0+6**	**23**	**500**
Semester-II					
PHY. 505	Cardiovascular Physiology	Core Course	3+0+0	3	100
PHY. 506	Respiratory Physiology	Core Course	3+0+0	3	100
PHY. 507	Endocrinology & Hepatobiliary system	Core Course	3+0+0	3	100
PHY. 508	Integumentary System & Special Senses	Core Course	3+0+0	3	100
PHY.526	Practical (Amphibian) in Physiology-II	Core course	0+0+4	4	100
PHY.550	Lab Rotation	Core course	0+0+3	3	-
PHY. 600	Thesis Plan/Synopsis writing	Core course	2+0+0	2	-
		Total Credits	**14+0+7**	**21**	**500**
Semester-III					
PHY.509	Gastrointestinal Physiology	Core course	3+0+0	3	100
PHY.510	Reproductive Physiology	Core course	3+0+0	3	100
RMB.501	Research Methodology and Biostatistics	Elective course	3+1+0	4	100
IPR.550	Bioethics & Intellectual Property Rights	Elective Course	3+0+0	3	NC
PHY.599	Seminar-II/Journal Club/ Assignments	Core course	2+0+0	2	50
PHY.527	Practical in Clinical Physiology-III	Core Course	0+0+2	2	100
PHY.550	Lab Rotation	Core course	0+0+4	4	-
		Total Credits	**14+1+6**	**21**	**450**
Semester-IV					
PHY.600	Thesis/Dissertation Work	Core course	0+0+20	20	100
PHY.511	Central Nervous System	Core Course	3+0+00	3	100
*Elective	Optional Elective course	Elective course	3+0+00	3	50
PHY.550	Lab Rotation	Core course	0+0+03	3	-
		Total Credits	**6+0+23**	**29**	**250**
		Grand Total Credits	**51+1+42**	**94**	**1700**
*** Choose any one**					
BMW.575	Biomedical Waste management	Elective course	3+0+0	3	50
ACA.575	Advances in Cancer Biology	Elective course	3+0+0	3	50
PGC.575	Principles of Medical Genetics	Elective course	3+0+0	3	50
GEP.575	Genomics and Proteomics	Elective course	3+0+0	3	50
RDT.575	Recombinant DNA Technology and Genetic Engineering	Elective course	3+0+0	3	50
Thesis/Dissertation work: Thesis/Dissertation work will begin in third semester. The proposal for Thesis/Dissertation work shall be finalized in second semester.					

SYLLABUS OF M.Sc. MEDICAL PHYSIOLOGY

SEMESTER-I	
Name of the Programme	**M.Sc. PHYSIOLOGY**
Name of the Course	**General & Cellular Physiology**
Course Code	**PHY.501**
Credit hours	**03**
Teaching Objective	The course of general physiology introduces basic concepts in physiology of human body. It emphasizes the concept of internal environment and homeostasis and the concept of feedback in a biological system. It also helps students to understand body fluid composition, different fluid compartments, water balance, and its disorders. Also, cell membrane structure and different mechanisms of membrane transport will be discussed. Cellular physiology including membrane ionic basis of excitability, action potential, and nerve block will be explained.
Learning Outcomes	i. Understand functional organization of human body & body fluids compartments, water balance and its disorders. ii. Recognize the cell membrane structure and principles of different mechanisms of membrane transport. iii. Understand concept of excitability and ionic basis of resting membrane potential & action potential and other types of membrane potential. iv. Define the concept of homeostasis and feedback mechanisms. v. Understand different types of ion channels and mechanisms of nerve block.

Unit No.	Content	Lectures
1.	**General & Cellular Physiology**: Cell as the living unit of the body, The internal environment, Homeostasis, Control systems, Organization of a cell, Physical structure of a cell Transport across cell membranes, Functional systems in the cells, Genetic code, gene and its expression. Cell cycle and its regulation	10
2.	General functional organization of human body	4
3.	Cell-organelles and their functions.	3
4.	Cell to cell and local communications, Transport across cell membrane Body fluid compartments: Define and explain	5
5.	Principles of control systems: General characteristics and components of biological control system. Hormonal control mechanism: Definition of hormones, receptors and target cells. Role of hormones in homeostasis.	10
6.	Technology: Stimulus, excitability, conductivity, contractility, refractory period, chronaxie, rheobase, summation etc.	5
7.	Membrane potential (resting and action potential)	4
8.	Receptor generator potential, properties and transduction	4
	Total	**45**

SEMESTER-I	
Name of the Programme	**M.Sc. PHYSIOLOGY**
Name of the Course	**Nerve Muscle Physiology**
Course Code	**PHY.502**
Credit hours	**03**
	i. To understand the mechanism of neuromuscular blocking agents

Teaching Objective	and the pathophysiology of myasthenia gravis, connecting basic science to clinical applications. ii. Students should be able to describe the molecular basis of muscle contraction and the various energy sources and metabolic pathways used by muscles. iii. The final objective is to introduce the fundamental properties of excitable tissue and the basic principles of electromyography (EMG), providing a foundational understanding of how nerve and muscle function can be clinically assessed.
Learning Outcomes	i. The primary objective is for students to learn the structure and functions of neurons and neuroglia, including the different types of nerve fibers and their properties. ii. Students should be able to explain the molecular basis of resting membrane potential and action potential, as well as the concept of a compound action potential. iii. Students will learn about the structure and transmission at the neuromuscular junction.

Unit No.	Content	Lectures
1.	Structure and functions of a neuron and neuroglia. Nerve fibre types, properties and function.	4
2.	Molecular basis of resting membrane and action potential, compound action potential, Recording.	4
3.	Structure and transmission across neuro-muscular junction.	3
4.	Neuro-muscular blocking agents.	4
5.	Pathophysiology of Myasthenia gravis and other applied aspects of NM junction.	3
6.	Types and structure of muscle fibers. Action potential in different muscle types (skeletal, smooth & cardiac).	4
7.	Molecular basis of muscle contraction.	4
8.	Energy sources and metabolism in muscle.	4
9.	Properties of excitable tissue. Basics of Electromyography (EMG).	3
	Total	**45**

SEMESTER-I	
Name of the Programme	**M.Sc. PHYSIOLOGY**
Name of the Course	**Hematology**
Course Code	**PHY.503**
Credit hours	**03**
Teaching Objective	Students will learn about the different types of blood cells (erythrocytes, leukocytes, platelets), their morphology, functions, and the process of hematopoiesis. i. Students will understand the complex process of hemostasis, including the physiology of coagulation and the factors that prevent clotting. ii. The instructor will teach the composition of blood, focusing on plasma and its constituents. They will detail the types, properties, and functions of plasma proteins, as well as the types of blood cells and the overall process of hematopoiesis. iii. The instructor will explain the genetic and serological basis of ABO and Rh blood groups. They will teach the principles of blood transfusion, including indications, potential hazards, and the

	proper storage of blood. The instructor will also cover the inheritance of blood groups and the management of hemolytic disease of the newborn.	
Learning Outcomes	i. Students will learn about the different types of blood cells (erythrocytes, leukocytes, platelets), their morphology, functions, and the process of hematopoiesis. ii. Students will understand the complex process of hemostasis, including the physiology of coagulation and the factors that prevent clotting.	
Unit No.	**Content**	**Lectures**
1.	Blood as a body fluid: Composition and functions of blood. Plasma: Normal constituents.	5
2.	**Plasma Proteins**: Types, concentrations, properties and functions.	5
3.	**Blood cells**: Types, distribution and overview of haematopoiesis. Erythrocytes – morphology, functions, fate, normal count, haemolysis. Erythropoiesis definition, stages and regulating factors. Blood indices and their clinical usefulness. Anaemias and polycythemia Leukocytes classification, morphology, normal counts, functions, development and related applied aspects. Platelets morphology, functions, development and related applied aspects.	10
4.	**Blood groups**: Agglutinogens and agglutinins, Iandsteiner's law, ABO and Rh group, minor blood groups Blood transfusion relation of blood groups, indications, hazards and storage of blood, inheritance, hemolytic disease of the new born.	10
5.	**Haemostasis**: Physiology of coagulation, tests for clotting, clot retraction, and anticoagulation, Bleeding and coagulation disorders. Reticuloendothelial system: Functions of spleen and lymph nodes.	10
6.	Immunity its types and disorders.	5
	Total	**45**

SEMESTER-I		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Renal Physiology**	
Course Code	**PHY.504**	
Credit hours	**03**	
Teaching Objective	i. To teach the organization and regulation of body fluid compartments, detailing the processes of urine formation: glomerular filtration, tubular reabsorption, secretion, and concentration. ii. Students will also introduce clinical topics like renal function tests, diuretics, renal failure, and the principles of artificial kidneys, dialysis, and renal transplantation, providing a comprehensive understanding of the kidney's role in health and disease.	
Learning Outcomes	i. Students will be able to describe the regulation of body fluids and the fundamental processes of urine formation. ii. Students will understand the clinical significance of renal physiology.	

Unit No.	**Content**	**Lectures**
1.	The Body Fluids and Renal Physiology Body fluid compartments and its regulation.	5
2.	Renal circulation. Urine formation involving processes of filtration, tubular reabsorption, secretion and concentration.	10
3.	Water diuresis and osmotic diuresis.	3
4.	Regulation of acid base balance.	4
5.	Structure and function of a Juxta glomerular apparatus.	3
6.	Renal mechanisms for the control of volume, blood pressure and ionic composition.	5
7.	Micturition and abnormalities of micturition. Artificial kidney, dialysis and renal transplantation.	10
8.	Renal Function test. Diuretics Renal failure	5
	Total	**45**

Name of the Course	**HUMAN VALUES AND ETHICS**
Course Code	**HVE.501**
Credit hours	**03**
Teaching Objective	i. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. ii. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. iii. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. iv. Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds
Learning Outcomes	i. By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. ii. They would have better critical ability. iii. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Unit No.	**Content**	**L+T**
Module 1	Introduction to Value Education (6 lectures and 3 tutorials for practice session) Lecture 1: Understanding Value Education Lecture 2: Self-exploration as the Process for Value Education Tutorial 1: Practice Session PS1 Sharing about Oneself Lecture 3: Continuous Happiness and Prosperity – the Basic Human Aspirations Lecture 4: Right Understanding, Relationship and Physical Facility Tutorial 2: Practice Session PS2 Exploring Human Consciousness Lecture 5: Happiness and Prosperity – Current Scenario Lecture 6: Method to Fulfill the Basic Human Aspirations Tutorial 3: Practice Session PS3 Exploring Natural Acceptance	5+4
Module 2	Harmony in the Human Being Lecture 7: Understanding Human being as the Co-existence of the Self and the Body Lecture 8: Distinguishing between the Needs of the Self and the Body Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body Lecture 9: The Body as an Instrument of the Self	7+3

	Lecture 10: Understanding Harmony in the Self Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self Lecture 11: Harmony of the Self with the Body Lecture 12: Programme to ensure self-regulation and Health Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body	
Module 3	Harmony in the Family and Society (6 lectures and 3 tutorials for practice session) Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction Lecture 14: Values in Human-to-Human Relationship Lecture 15: 'Trust' – the Foundational Value in Relationship Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust Lecture 16: 'Respect' – as the Right Evaluation Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect Lecture 17: Understanding Harmony in the Society Lecture 18: Vision for the Universal Human Order Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal	6+3
Module 4	Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session) Lecture 19: Understanding Harmony in the Nature Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature Lecture 21: Realizing Existence as Co-existence at All Levels Lecture 22: The Holistic Perception of Harmony in Existence Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence	4+2
Module 5	Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session) Lecture 23: Natural Acceptance of Human Values Lecture 24: Definitiveness of (Ethical) Human Conduct Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order Lecture 26: Competence in Professional Ethics Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education Lecture 27: Holistic Technologies, Production Systems and Management Models Typical Case Studies Lecture 28: Strategies for Transition towards Value-based Life and Profession Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Orde	6+3
Suggested Readings:		
	Text Book and Teachers Manual a. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 b. **b.** The Teacher's Manual Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2	
	Reference Books	

	1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999. 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3. The Story of Stuff (Book). 4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi 5. Small is Beautiful - E. F Schumacher. 6. Slow is Beautiful - Cecile Andrews 7. Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal 9. Rediscovering India - by Dharampal 10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi	

SEMESTER-I		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Practicals-I**	
Course Code	**PHY.525**	
Credit hours	**03**	
Teaching Objective	i. To instruct on the proper use of a compound microscope and introduce key hematological tests. ii. To develop students' skills in blood smear analysis and differential cell counts. iii. To explain tests related to blood properties and coagulation	
Learning Outcomes	i. Students will be able to perform basic microscopic and hematological procedures. ii. Students will acquire skills in blood cell morphology and differentiation. iii. Students will understand and apply tests related to blood function. iv. Students will be able to determine blood groups and understand their significance	
Unit No.	**Content**	**Lectures**
1.	Study of compound microscope RBC's. _ Estimation of Haemoglogin (Hb). _ To determine the Total Leucocyte Count (TLC). _ To determine the Total Erythrocyte Count (RBC). _ Preparation of blood smear and identification of different cells present in blood. _ To determine the Differential Leucocyte Count (DLC). _ Determination of Absolute Eosinophil Count. _ Determination of ESR and PCV _ Platelet Count _ Determination of Specific Gravity of Blood. _ Determination of BT and CT. _ Determination of Osmotic Fragility of RBC's. _ Determination of Blood Groups.	45

SEMESTER-II		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Cardiovascular Physiology**	
Course Code	**PHY.505**	
Credit hours	**03**	
Teaching Objective	i. To provide a comprehensive understanding of the heart as a pump and the entire cardiovascular system. ii. To introduce the principles and clinical applications of electrocardiography (ECG). iii. To explain the regulation of cardiac output and hemodynamics. Instructors will define cardiac output, iv. To detail the control of blood pressure and regional circulation. Instructors will define arterial blood pressure, its measurement, and its determinants.	
Learning Outcomes	i. Students will be able to describe the mechanical and electrical events of the cardiac cycle. ii. Students will be able to interpret an electrocardiogram (ECG). iii. Students will understand the regulation of blood flow and cardiac output. iv. Students will understand the control of blood pressure and its clinical implications.	
Unit No.	**Content**	**Lectures**
1.	**Cardiovascular system**: Heart as a mechanical pump: Design of systemic and pulmonary circulation. Introduction of the venous pressure, flow and resistance. Types of blood vessels and their functions. Properties of myocardial cells: Site of generation of cardiac impulse- pace maker tissue. Mechanisms of spontaneous generation of impulses.	4
2.	Conducting system of heart and its importance. Electrical properties of working myocardial cells. Molecular basis of contraction and excitation contraction coupling (in brief)	4
3.	All or none phenomenon, length-tension relationship. Frank-Starling Law, neural influences. Effect of ions and chemical on myocardial contractility.	3
4.	Cardiac cycle: Mechanical and electrical events, pressure volume relationship	4
5.	**Electrocardiography**: Definition, uses, principle, waves and their explanations. ECG recording techniques.	3
6.	Cardiac arrhythmias and their ECG interpretation.	4
7.	**Cardiac output**: Definition, normal values and variations, major determinants of cardiac output and regulation, Fick's principle and its application, indicator dye methods of measurement, Regulation of heart rate and stroke volume.	4
8.	**Haemodynamics**: Definition of terms- pressure, flow, resistance, velocity etc. Laminar and turbulent flow, Poiseuille law, factors affecting blood flow and resistance, critical closing pressure Various types of circulation, local regulation of blood flow to tissues.	4
9.	**Arterial Blood Pressure**: Definition, normal value, variations, measurement, mean arterial pressure (MAP) and its determinants.	3
10.	**Short term reflex control**: baroreceptors and their significance. Mechanism of reflex control and its limitations.	3

	Long term control: renal body fluid – pressure control mechanism, hypertension.	
11	**Regional circulation**: Coronary, cerebral, cutaneous, splanchnic, skeletal muscle and foetal. Normal values, special features and regulation.	4
12.	Cardiovascular changes during exercise. Cardiac failure, circulatory shock.	4
	Total	**45**

SEMESTER-II		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Respiratory Physiology**	
Course Code	**PHY.506**	
Credit hours	**03**	
Teaching Objective	i. To provide a comprehensive understanding of the functional anatomy and mechanics of breathing. ii. To explain the principles of pulmonary gas exchange and transport. iii. To detail the neural and chemical regulation of respiration. iv. To introduce respiratory responses to unusual environments and pathological conditions.	
Learning Outcomes	i. Students will be able to describe the mechanics of breathing and interpret spirometric data. ii. Students will understand the processes of gas exchange and transport in the blood. iii. Students will be able to explain the neural and chemical control of breathing. iv. Students will understand the physiological responses to environmental and disease states.	
Unit No.	**Content**	**Lectures**
1.	**Functional anatomy of respiratory system** Mechanics of breathing: Movements of thoracic cage during respiration, muscles involved, pressure-volume inter-relationships, lung compliance – surfactant, airway resistance, work of breathing.	4
2.	Spirometry, lung volumes & capacities: Definitions, normal values, significance and special features.	4
3.	**Pulmonary gas exchange**: Alveolar-capillary membranes, diffusion capacities, partial pressure gradients and factors influencing diffusion of gases, measurement of diffusion capacity using carbon monoxide.	3
4.	Applied physiology shunt and alveolar-capillary block Ventilation perfusion ratio and its importance in respiratory diseases.	4
5.	**Gas Transport** Oxygen transport – factors influencing the combination of haemoglobin with oxygen, oxygen dissociation curve- plotting, features, physiological advantage of its shape, factors affecting its shift and Bohr's effect.	3
6.	**Carbon dioxide transport** – tissue uptake, carriage in blood and release at the lungs importance of red blood cell, chloride shift, role in acid base balance, Haldane effect.	4
7.	**Regulation of respiration**: Neural control – medulla, pons and vagus. Chemo-receptors: peripheral and central, chemical and non-chemical influences on respiration, integrated responses.	4
8.	**Respiration in unusual environments**: High attitude hypoxia and space flight.	4

	Deep sea diving: nitrogen narcosis, Hyperbaric oxygen and oxygen toxicity.	
9.	**Abnormal breathing**: Apnoea, hyperpnoea, tachypnoea, dyspnoea, Chynestokes breathing and Biot's breathing- definition, features and physiological basis. Hypoxia, cyanosis.	3
10.	**Artificial respiration**: Definition, types, principles, indications, advantages and disadvantages. Pulmonary function tests Pulmonary abnormalities.	3
	Total	**45**

SEMESTER-II		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Endocrinology and Hepatobiliary system**	
Course Code	**PHY.507**	
Credit hours	**03**	
Teaching Objective	i. To provide a comprehensive overview of endocrinology and hormone function. ii. To explain the functions of the liver and associated digestive organs.	
Learning Outcomes	i. Students will be able to describe the physiological actions and regulation of key hormones. ii. Students will understand the functions of the liver and gallbladder and their clinical relevance.	
Unit No.	**Content**	**Lectures**
1.	**General Endocrinology** Mechanism of action and Regulation of hormones Physiological actions and applied aspects of pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas and hypothalamus, Growth Hormone: Estimation and assessment of Hormones. Pineal gland and local hormones.	25
2.	**Liver: Functions** Entero hepatic circulation Bile formation, secretion, regulation and jaundice Physiological basis of liver function tests Gall bladder: Functions, Mechanism and regulation of gall bladder contraction, applied aspects and Oral cholecystography	20
	Total	**45**

SEMESTER-II		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Integumentary System & Special Senses**	
Course Code	**PHY.508**	
Credit hours	**03**	
Teaching Objective	i. To explain the structure and functions of the skin and its appendages. ii. To provide a comprehensive understanding of the special senses: vision, hearing, taste, and smell.	
Learning Outcomes	i. Students will be able to describe the layers of the skin and the structure and function of its appendages. ii. Students will understand the physiological mechanisms of the special senses and their clinical relevance.	
Unit No.	**Content**	**Lectures**
1.	**SKIN**: Structure & Functions: Layers: Epidermis, Dermis and Hypodermis	6
2.	**Hair**: Types: vellus and terminal Structure: Follicle and bulb (shaft, inner root sheath, outer root sheath, glassy membrane)	8
3.	**Nail**: Nail plate, nail folds, nail matrix, nail bed, hyponychium	5
4.	**Sweat glands**: eccrine (most numerous, covering almost the entire body) and apocrine (only in the axilla and genitalia) Sebaceous glands: Cover the entire body and secrete sebum (oily and fatty)	6
5.	**Special Senses** Optics of vision Receptors & neural functions of retina, Colour vision, Perimetry, Visual pathways, Cortical visual function, Functions of external and middle ear, Cochlea Semicircular canals, Auditory pathways, Cortical auditory function, Deafness & hearing aids, Primary taste sensations, Taste buds, Transduction & transmission of taste signals, Perception of taste, Peripheral olfactory mechanisms, Olfactory pathways, Olfact01Y perception	20
	Total	**45**

SEMESTER-II		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Practical-II**	
Course Code	**PHY.501**	
Credit hours	**03**	
Teaching Objective	i. To instruct on the principles of muscle contraction and its properties using an amphibian model. ii. To demonstrate the unique properties of cardiac muscle and other physiological concepts.	
Learning Outcomes	i. Students will be able to perform and analyze experiments on skeletal muscle contraction. ii. Students will understand the unique properties of cardiac muscle and other fundamental physiological laws.	
Unit No.	**Content**	**Lectures**
1.	**Amphibian** _ Recording of simple muscle twitch (SMT). _ To study the effect of temperature on SMT. _ To study effect of load on SMT. _ Effect of increase in strength of stimulus on skeletal muscle contraction. _ Effect of two successive stimuli on SMT. _ Effect of increasing frequency of stimulus on SMT. _ Genesis of fatigue. _ Measurement of Blood pressure. _ To study properties of Heart muscle—Autorhythmicity and Conductivity. _ To study the properties – Refractory Period and Extra Systole (ES) of Heart Muscle. _ To study All or None law and Staircase phenomenon.	45
	Total	**45**

SEMESTER-III		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Gastrointestinal Physiology**	
Course Code	**PHY.509**	
Credit hours	**03**	
Teaching Objective	i. To provide a comprehensive overview of the functions and regulation of the gastrointestinal (GI) system. ii. To connect the physiology of digestion and absorption with common GI disorders and nutrition.	
Learning Outcomes	i. Students will be able to describe the physiological functions and regulation of the entire GI tract. ii. Students will understand the mechanisms of digestion and absorption and their clinical relevance.	

Unit No.	**Content**	**Lectures**
1.	Introduction to gastrointestinal Physiology: Functions of GI System-individual parts. Regulation of GI functions – general overview.	5
2.	**Oral Cavity**: Mastication and digestion in mouth and its importance. **Salivary secretion**: Role of salivary glands.	5
3.	**Physiology of deglutition**: Definition, stages and neural control and applied aspects.	4
4.	**Stomach**: Overview of functions _ Physiology of gastric secretion – mechanism, composition, function and control.	5
5.	**Gastric motility** – characteristics and control, gastric emptying and antral pump mechanism, peptic ulcer.	5
6.	**Pancreatic secretions**: Composition, mechanism, functions and control.	3
7.	Small intestine: Secretion, movement and control. Large intestine: Functions, secretions, movements.	5
8.	Gastrointestinal hormones and their role in secretomotor functions of the gut.	5
9.	**Defaecation**: Mechanism and control. _ Physiology of vomiting, diarrhoea, constipation. _ Digestion and absorption. _ Nutrition and vitamins.	5
	Total	**45**

SEMESTER-III		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Reproductive Physiology**	
Course Code	**PHY.510**	
Credit hours	**03**	
Teaching Objective	i. To provide a comprehensive understanding of the male and female reproductive systems and their hormonal regulation ii. To explain the physiology of fertilization, pregnancy, and related clinical topics.	
Learning Outcomes	i. Students will be able to describe the physiological processes of male and female reproduction and their hormonal control. ii. Students will understand the physiology of pregnancy, childbirth, and lactation, and related clinical issues.	
Unit No.	**Content**	**Lectures**
1.	Introduction: Sexual differentiation and development.	5
2.	**Male reproductive system**: Primary and accessory organs and their functions. Spermatogenesis and its regulation. Testosterone- secretion, transport, metabolism, mechanism and physiological actions Control of testicular function – feedback mechanism and abnormalities.	10
3.	**Female reproductive system**: Physiology of menstrual cycle: Physiology of ovulation and its detection Ovarian hormones – Estrogen and progesterone – physiological actions and mechanism of action	10
4.	Control of ovarian function: feedback mechanism, menopause and abnormalities.	10
5.	Physiology of fertilization and implantation. Physiology of pregnancy: Endocrine changes, foeto-placental unit, changes in mother during pregnancy, tests for pregnancy Physiology of parturition: Role of oxytocin Physiology of lactation: Role of oxytocin and prolactin Infertility, contraception	10
	Total	**45**

Name of the Course	RESEARCH METHODOLOGY AND BIOSTATISTICS
Course Code	RMB.501
Credit hours	04
Teaching Objective	To equipping learners with the knowledge and skills to design, conduct, and interpret research, understand statistical concepts, and apply them in their respective fields. This involves developing abilities in formulating research questions, selecting appropriate research designs, collecting and analyzing data, and reporting findings ethically includes defining research, its purpose, scope, and various types (e.g., qualitative, quantitative, experimental, observational).
Learning Outcomes	Students get an idea about collection, interpretation and presentation of statistical data.

Unit No.	Content	Lectures
1.	Definitions-Scope of Biostatistics- Variables in biology, collection, classification and tabulation of data- Graphical and diagrammatic representation. Measures of central tendency – Arithmetic mean, median and mode. Measures of dispersionRange, standard deviation, Coefficient of variation	15
2.	Correlation – Meaning and definition - Scatter diagram –Karl pearson's correlation coefficient. Rank correlation. Regression: Regression in two variables – Regression coefficient problems – uses of regression	12
3.	Test of significance: Tests based on Means only-Both Large sample and Small sample tests - Chi square test - goodness of fit. Analysis of variance – one way and two way classification. CRD, RBD Designs	15
4.	Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs	12
5.	Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements – Techniques – Types of scale.	10
	Total	**64**

Suggested Books

Sr. No.	Authors/ Name of Books/Publisher
1.	Deepak Chawla, Neena Sondhi, Research Methodology Concepts and Cases, Vikas books publishers, 2th edition, 2016
2.	Donald H. McBurney -Theresa L. White "Research Methods" (Cengage learning India Pvt. Ltd), 5th edition, 2006
3.	B. K. Mahajan, Methods in Biostatistics: for medical students and Research workers. Kothari Book Depot, Mumbai, 7th edition

Name of the Course	**BIOETHICS AND INTELLECTUAL PROPERTY RIGHT**
Course Code	**IPR.550**
Credit hours	**03**
Teaching Objective	Students will gain a comprehensive understanding of foundational ethical principles and their application to medicine and healthcare. They will learn to analyze and resolve complex ethical dilemmas in clinical and research settings, considering topics from patient rights and end-of-life care to emerging biomedical technologies. Additionally, students will develop a solid grasp of intellectual property rights (IPR), particularly patents in biotechnology, and learn to critically evaluate the ethical and legal conflicts surrounding IPR, such as access to medicine and biopiracy.
Learning Outcomes	By the end of this course, students will be able to: i. Apply ethical theories like utilitarianism and deontology to real-world healthcare scenarios. ii. Critically evaluate the four core principles of bioethics: autonomy, beneficence, non-maleficence, and justice. iii. Demonstrate a systematic approach to ethical decision-making in both clinical practice and medical research. iv. Analyze and navigate the legal and ethical landscape of intellectual property, including patenting biological materials and managing patent applications. v. Debate and articulate informed positions on major controversies at the intersection of bioethics and IPR, such as compulsory licensing and the protection of traditional knowledge.

Unit No.	Content	Lectures
1.	**Introduction to ethics**: Exploration of fundamental ethical concepts, theories (like utilitarianism and deontology), and their application to medicine and healthcare. **Core principles of bioethics**: In-depth analysis of the four central principles: autonomy (respect for the patient's right to choose), beneficence (the duty to do good), non-maleficence (the duty to do no harm), and justice (the fair distribution of benefits and burdens). **Historical context**: Study of significant historical events that shaped modern bioethics, such as the Nuremberg Code and the Tuskegee syphilis study. **Ethical decision-making**: Training in systematic approaches for resolving ethical dilemmas in clinical and research settings.	8
2.	**Ethical issues in clinical practice:** **Patient rights**: Understanding patient rights, informed consent, truth-telling, and confidentiality. **Beginning-of-life issues**: Discussion of ethical considerations related to reproductive technologies, abortion, contraception, and genetic screening. **End-of-life care**: Moral and legal issues surrounding euthanasia, physician-assisted suicide, advance directives, and organ transplantation. **Doctor-patient relationships**: Exploration of the power dynamics, trust, and communication necessary for therapeutic relationships.	7
3.	**Ethical issues in medical research** **Human experimentation**: Ethical guidelines for clinical trials, research involving vulnerable populations (e.g., children, prisoners), and the use of placebos.	5

	Biomedical technology: Ethical analysis of emerging technologies such as stem cell research, genetic engineering, cloning, and artificial intelligence in medicine. **Animal rights**: Debate surrounding the ethical use of animals in research and testing. **Biobanking**: Ethical issues involved in the collection, storage, and use of human biological samples for research.	
4.	**Introduction to IPR** **Fundamentals of IPR**: Definition and rationale behind intellectual property, including its role in incentivizing innovation in the healthcare industry. **Types of IP**: Overview of the main forms of IPR, including patents, copyrights, trademarks, and geographical indications, with relevance to the life sciences. **International framework**: Study of international agreements like the World Intellectual Property Organization (WIPO) and the TRIPS Agreement (Trade-Related Aspects of Intellectual Property Rights). Indian Position on WTO Regime. General Agreement on Trade and Tariff (GATT).	10
5.	**Patents in biotechnology and medicine** **Patentability criteria**: Detailed examination of the requirements for patenting biotechnological inventions, including novelty, inventive step (non-obviousness), and industrial applicability. **Patenting biological materials**: Analysis of patenting issues related to genes, microorganisms, and other life forms, referencing landmark court cases such as *Diamond v. Chakrabarty*. **Indian patent law**: Indian Patent Act 1970 (Patent Amendment Acts-1999, 2002 and 2005) **Patent process**: Practical guidance on drafting and filing patent applications and managing a patent portfolio.	5
6.	**Ethical and legal controversies in IPR** **Biopiracy and traditional knowledge**: Investigation of the appropriation of traditional knowledge and biological resources by pharmaceutical companies, Patent Case study: Basmati Case, Neem Controversy, Turmeric Case **Access to medicine**: Examination of the ethical conflict between a company's patent rights and the public's need for affordable medicines. This includes discussions on compulsory licensing. **Data and privacy**: IPR issues related to medical data, digital technologies, and the protection of patient information. **Case studies**: Use of real-world cases to explore conflicts between patent protection, patient welfare, and global health priorities.	10
	Total	**45**

Suggested Books:

Important Links
http://www.w3.org/IPR/ http://www.wipo.int/portal/index.html.en http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html www.patentoffice.nic.in www.iprlawindia.org/ - 31k - Cached - Similar page http://www.cbd.int/biosafety/background.shtml http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html Bioethics - by Ellen Frankel Paul , Fred D. Miller, Jeffrey Paul , Fred Dycus Miller http://www.accessexcellence.org/RC/AB/IE/#Anchor-Bioethics-6296 www.bioethics.net Bioethics & Science http://www.americanprogress.org/issues/domestic/science?_kk=bioethics&_kt=21a1e10d-48e4-44bc-8b39- 21c695383746 **The Stem cell debate** http://www.billmuehlenberg.com/2005/09/02/the-stem-cell-debate/

SEMESTER-III		
Name of the Programme	**M.Sc. PHYSIOLOGY**	
Name of the Course	**Practical-III**	
Course Code	**PHY.525**	
Credit hours	**03**	
Teaching Objective	i. To instruct on the fundamental clinical skills for cardiovascular and respiratory system assessment. ii. To provide practical training in the assessment of neurological and sensory functions	
Learning Outcomes	i. Students will be able to perform and interpret basic cardiovascular and respiratory function tests. ii. Students will be able to conduct a basic neurological and sensory examination.	
Unit No.	**Content**	**Lectures**
1.	_ Clinical examination and recording of Arterial Pulse. _ Recording of Systemic Arterial BP and effect of posture and exercise. _ Recording of 12 lead ECG _ Plethysmography (Measurement of Blood Flow). _ Stethography. _ Vitalography. _ Spirometry. _ Measurement of BMR. _ Cardiac Efficiency Tests. _ Perimetry. _ Auditory Function tests. _Examination of Cranial Nerves. _ Examination of Motor System. _ Examination of Sensory System. _ Reaction time (VRT & ART).	45
	Total	**45**

SEMESTER-IV		
Name of the Course	**Central Nervous System**	
Course Code	**PHY.511**	
Credit hours	**03**	
Teaching Objective	1. To establish a foundational understanding of the structural organization of CNS and the cellular mechanisms that govern its function, including synaptic transmission and reflex activity. 2. To analyze the complex processes by which the CNS integrates sensory information.	
Learning Outcomes	1. Students will be able to describe and illustrate the key anatomical pathways and the physiological properties of the neuron and synapse. 2. Students will be able to explain and predict the functional consequences and applied aspects of damage or dysfunction within the motor system.	
Unit No.	**Content**	**Lectures**
1.	**Introduction:** -Organization of CNS overview -synapse, properties of Synapse -Neurotransmitters -Reflex	08
2.	**Sensory system:** -Physiology of Receptor -Receptor potential -Ascending tracts - Cortex , Physiology of Pain	11
3.	**Motor System:** -Pyramidal Tract -Cerebellum and its functions -Basal ganglia and Applied aspect -Upper & Lower motor neurons	14
4.	**Higher Functions:** -Hypothalamus -Limbic system -Learning and Memory -Sleep and EEG - CSF and its Circulation	12
	Total	**45**

Name of the Course	**THESIS WORK-IV**
Course Code	**PHY.600**
Credit hours	**15**
Teaching Objective	i. To train students in independent biomedical research. ii. To provide experience in experimental design, data collection, and analysis.
Learning Outcomes	Students will be able to: i. Design and execute an independent, hypothesis-driven research project in a relevant area of clinical or laboratory medical biochemistry. ii. Apply appropriate statistical and bioinformatic methods to analyze and critically interpret complex experimental data. iii. Produce a comprehensive scientific thesis that adheres to established academic conventions for structure, citation, and ethical reporting.

Sr. No.	**Content**
1.	Review of literature search
2.	Laboratory base research work
3.	Compilation of data
4.	Analysis of data
5.	Thesis writing & presentation

Elective courses

SEMESTER-IV		
Name of the Course	**BIOMEDICAL WASTE MANAGEMENT**	
Course Code	**BWM.575**	
Credit hours	**03**	
Teaching Objective	The objective of the paper is to · Teach how to manage biomedical waste · Provide Knowledge about various biomedical management and handling rules · Learn the treatment and disposable techniques used for biomedical management · Teach biomedical waste management rules.	
Learning Outcomes	Understand how to manage biomedical waste Know various biomedical management and handling rules Learn the treatment and disposable techniques of biomedical management. Know various biomedical waste management rules.	
Unit No.	Content	Lectures
1.	Waste disposal management, Hospital waste management, Biosafety-regulatory framework for GMOs, bioethics and its socio economic impact, Hazards associated with poor health care waste management	10
2.	Characterization of medical waste- Bio-medical wastes (Management and Handling) Rules, 1998, Amendments and guidelines, segregation, packaging, storage, transport of infectious waste. Techniques of Biomedical waste management. Health and safety rules. Protocols, issues, and challenges in transportation of Biomedical waste.	10
3.	Treatment method- Autoclave, Hydroclave, Microwave, Chemical Disinfection, Solidification and stabilization, Bioremediation, Thermal Conversion Technologies, accumulation and storage of hazardous waste, land disposal of hazardous waste, other treatment and disposal method. Common Hazardous Waste Treatment Facilities (TSDF)	11
4.	Biomedical waste management rule: Biomedical wastes categories and their segregation, collection, treatment, processing, and disposal options, Standards For Treatment and Disposal Of Bio-Medical wastes, Standards for autoclaving of bio-medical waste, standards of microwaving, standards for deep burial, standards for the efficacy of chemical disinfection, standards for dry heat sterilization, standards for liquid waste	14

Suggested Readings

Sr. No.	Authors/ Name of Books/Publisher
1.	Biomedical Waste Management: R. Radharisham
2.	Hospital Waste Management's-A guide for self-assessment and review: ShishirBasarkar
3.	Biomedical Waste Disposal: Anantpreet Singh and Sukhjit Kaur
4.	Medical Waste Management and Disposal: V. J. Landrum

SEMESTER-IV	
Name of the Course	**Principles of Medical Genetics**
Course Code	**PGC.575**
Credit hours	**03**
Teaching Objective	i. To provide a comprehensive foundation in Mendelian and

	non-Mendelian genetics, cytogenetics, and genetic variation. ii. To connect genetics to developmental biology, immunology, population dynamics, and modern research.
Learning Outcomes	i. Students will be able to describe and analyze patterns of genetic inheritance and chromosomal abnormalities. ii. Students will understand the broader applications of genetics in various fields and be able to apply population genetics principles.

Unit No.	Content	Lectures
1.	**Mendelian Genetics:** Introduction to human genetics; background and history; types of genetic diseases; role of genetics in medicine. Human pedigrees; patterns of single gene inheritance-autosomal recessive; autosomal dominant; X linked inheritance. Complicating factors-incomplete penetrance; variable expression; multiple alleles; co dominance; sex influenced expression; hemoglobinopathies-genetic disorders of hemoglobin and their diseases.	4
2.	**Non Mendelian inheritance patterns:** Mitochondrial inheritance; genomic imprinting; Lyon hypothesis; isodisomy. Complex inheritance– genetic and environmental variation; Heritability; twin studies; behavioral traits; analysis of quantitative and qualitative traits.	4
3.	**Cytogenetics:** Cell division and errors in cell division; Non disjunction; Structural and numerical chromosomal abnormalities–deletion; duplication; translocation; sex determination; Role of Y chromosome. Genetic recombination; disorders of sex chromosomes and autosomes. Molecular cytogenetics–Fluorescence In Situ Hybridization (FISH); Comparative Genomic Hybridization (CGH).	7
4.	**Developmental genetics:** Genes in early development; maternal effect genes; pattern formation genes; homeotic genes; and signaling and adhesion molecules.	5
5.	**Immunogenetics:** Major histocompatibility complex; immunoglobulin genes-tissue antigen and organ transplantation. Single gene disorders of immune system.	5
6.	**Genetic variation:** Mutations; kinds of mutation; agents of mutation; genome polymorphism; uses of polymorphism.	5
7.	**Gene maping and human genome project:** Physical mapping; linkage and association.	5
8.	**Population genetics and evolution:** Phenotype; genotype; gene frequency; Hardy-Weinberg law; factors distrubing Hardy-Weinberg equilibrium; mutation selection; migration; gene flow; genetic drift. human genetic diversity; origin of major human groups.	5
	Total	**45**

Suggested Books:

Sr. No.	Authors/ Name of Books/Publisher
1.	S.R. Maloy, J.E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Bartlett Publishers, 1994.
2.	Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.
3.	Mange E J and Mange A. P., Human genetics, 2nd Edition, Sinauer Associates publications, 1999.
4.	Hartl L D and Jones B, Analysis of genes and genomes, 3rd Edition, Jones and Bartlett Publishers, 1994.

Name of the Course	Recombinant DNA Technology and Genetic Engineering
Course Code	RDT.575
Credit hours	03
Teaching Objective	i. To provide a comprehensive foundation in the core techniques and tools of molecular biology and genetic engineering ii. To instruct on advanced molecular techniques, their applications, and their clinical relevance.
Learning Outcomes	i. Students will be able to describe and apply the fundamental principles of genetic engineering. ii. Students will be able to explain and apply advanced molecular techniques for research and clinical purposes.

Unit No.	Content	Lectures
1.	**Basics Concepts:** DNA Structure and properties; restriction enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labeling of DNA: nick translation, random priming, radioactive and non-radioactive probes. Hybridization techniques: Northern, Southern and Colony hybridization, fluorescence in situ hybridization; chromatin immunoprecipitation; DNA-Protein interactions-electromobility shift assay; DNaseI footprinting; methyl interference assay	10
2.	**Cloning Vectors:** Plasmids; bacteriophages; M13 mp vectors; PUC19 and bluescript vectors, phagemids; lambda vectors; insertion and replacement vectors; EMBL; cosmids; artificial chromosome vectors (YACs; BACs); animal virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; expression vectors; pMal; GST; pET based vectors. Protein purification: His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies; baculovirus and pichia vectors system, plant based vectors, ti and ri as vectors, yeast vectors, shuttle vectors.	9
3.	**Cloning Methodologies:** Insertion of foreign DNA into host cells; transformation; construction of libraries; isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; jumping and hopping libraries; Southwestern and Far-western cloning; protein-protein interactive cloning and yeast two hybrid system; phage display; principles in maximizing gene expression	8
4.	**PCR and its Applications:** Primer design; fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T vectors; proof reading enzymes; PCR in gene recombination; deletion; addition; overlap extension; and SOEing; site specific mutagenesis; PCR in molecular diagnostics; viral and bacterial detection; PCR based mutagenesis, mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)	10
5.	**Sequencing methods**; Enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical Synthesis of oligonucleotides; introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; gene knockouts and gene therapy;	8

	creation of knock out mice; disease model; somatic and germ-line therapy-in vivo and ex-vivo; suicide gene therapy; gene replacement; gene targeting; transgenics; cDNA and intragenic arrays; differential gene expression and protein array.	
	Total	**45**

Suggested Books

Sr. No.	Authors/ Name of Books/Publisher
1.	S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2.	J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3.	Brown TA, Genomes, 3rd ed. Garland Science 2006
4.	Selected papers from scientific journals and Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

Name of the Course	**Genomics and Proteomics**
Course Code	**GEP.575**
Credit hours	**03**
Teaching Objective	i. To provide a foundational understanding of genomics and bioinformatics. ii. To instruct on modern high-throughput technologies in genomics and proteomics
Learning Outcomes	i. Students will be able to describe the organization of genomes and apply computational tools for sequence analysis ii. Students will understand the principles and applications of genomics and proteomics technologies

GEP.575: Credits: 3

Unit No.	Content	Lectures
1.	**Introduction to Genomics:** Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; Computational analysis of sequences- finding genes and regulatory regions; gene annotation; similarity searches; pairwise and multiple alignments; alignment statistics; prediction of gene function using homology, context, structures, networks; genetic variation-polymorphism, deleterious mutation; phylogenetics; tools for genome analysis– PCR, RFLP, DNA fingerprinting, RAPD, automated DNA sequencing; linkage and pedigree analysis; construction of genetic maps; physical maps, FISH to identify chromosome landmarks.	10
2.	**Genome sequencing:** Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map, DNA sequence; DNA sequencing and sequence assembly; Model organisms and other genome projects; comparative genomics of relevant organisms such as pathogens and non-pathogens; evolution of a pathogen e.g. Hepatitis C virus or a bacterial pathogen; taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing;	9
3.	**DNA Microarray technology:** Basic principles and design: cDNA and oligonucleotide arrays; Applications: Global gene expression analysis, Comparative transcriptomics, differential gene expression; genotyping/SNP detection; detection technology; computational analysis of microarray data.	6

4.	**Proteomics:** Overview of protein structure-primary, secondary, tertiary and quarternary structure; Relationship between protein structure and function; outline of a typical proteomics experiment; identification and analysis of proteins by 2D analysis; spot visualization and picking; tryptic digestion of protein and peptide fingerprinting; mass spectrometry : ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; clinical proteomics and disease biomarkers; Prions; proteins in disease; protein-protein interactions: Solid phase ELISA, pull-down assays (using GST-tagged protein), far western analysis, by surface plasmon resonance technique, yeast two hybrid system, phage display; Protein interaction maps; Protein arrays-definition, applications- diagnostics, expression profiling.	10
5.	**Human disease genes**; DNA polymorphism including those involved in disease; hemoglobin and the anemias; phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); ligation based assays (allele specific oligonucleotide ligation); polymorphism detection without sequence information: SSCP; proteomics and drug discovery; high throughput screening for drug discovery; identification of drug targets; pharmacogenomics and pharamacogenetics and drug development; toxicogenomics; metagenomics.	10
	Total	**45**

Suggested Books:

Sr. No.	Authors/ Name of Books/Publisher
1.	Brown TA, Genomes, 3rd Edition, Garland Science, 2006.
2.	Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
3.	Bioinformatics, 2nd Edition, Benjamin Cummings, 2007.
4.	Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
5.	Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.
6.	Ed. C. Cantor and C.L. Smith, Genomics: The Science and Technology behind the Human Genome Project, Wiley-Interscience, 2000.
7.	G. Gibson, S. V. muse, A Primer of Genome Science, Sinauer Associates Inc. Publishers, 2002.
8.	H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press, 2006.
9.	E. de Hoffman and V. Stroobant, Mass Spectrometry, 2nd Edition, Wiley. 2002.

Name of the Course	Advances in Cancer Biology
Course Code	ACA.575
Credit hours	03
Teaching Objective	i. To provide a comprehensive understanding of the epidemiology, genetic, and molecular basis of cancer. ii. To introduce students to cancer diagnosis, research techniques, and emerging therapies.
Learning Outcomes	i. Students will be able to explain the etiological and molecular foundations of cancer. ii. Students will be able to identify and describe key techniques for cancer diagnosis and research.

Unit No.	Content	Lectures
1.	Cancer Epidemiology, Geographic, Environmental and age factors: Genetic basis of cancer, autosonal dominant/ recessive inherited cancer, DNA damage. Familial cancer, Non-Genetic basic of cancer. Chronic inflammation, precancerous condition, oxidative stress.	5
2.	Molecular basis of cancer, introduction, essential alteration for malignant transformation, proto-oncogenes, oncogenes, oncoproteins. Growth factors and their receptors, signal transducing proteins, insensitivity to growth inhibition & escape from senescence, role of tumor suppressors genes, genomic instability, dysregulation of cancer associated genes.	10
3.	Carcinogenic agents & their cellular interactions, radiation (Ionizing and Non Ionizing), microbial (Oncogenic RNA & DNA viruses).	5
4.	Stem cells, history and axis of research, what makes stem cell a stem cell, stem cell therapies. Future regeneration medicine	10
5.	Bioinformatics and cancer	5
6	Biologically important techniques in cancer research, laboratory diagnosis of cancer, histological & cytological. Immuno histro chemistry, flow cytometery, molecular diagnosis (Polymerase chain reaction, fluorescent in-situ hybridization). Cytogenetic Techniques (Karyotyping), DNA Microarray, comparative genomic hybridization, snp chips, gene sequencing, tumor markers.	10
	Total Credits	45