Department of Microbiology

Faculty of Allied Health Sciences

SGT UNIVERSITY

Shree Guru Gobind Singh Tricentenary University
Gurugram-122505

Syllabus & Bye-laws

M.Sc. Molecular Biology & Molecular Diagnostics

Duration: 2 years (4 Semesters)

W.e.f. Academic Session 2021-22

MASTER DEGREE PROGRAMMES IN ALLIED HEALTH SCIENCES

ORDINANCE

1. **Scope of the Ordinance:**

This ordinance will be applicable to the M.Sc Molecular Biology and Molecular Diagnostics programme

2. **Duration of the Programmes:**

The duration of all M.Sc. programmes mentioned above shall be of two academic years consisting of four (4) semesters. On successful completion of all the four semesters, the student will be awarded M.Sc. degree with the nomenclature given under Clause (1) above. The student shall complete the programme within a maximum period of 4 years from the date of admission to the first semester, failing which he/she will be disqualified from the programme.

3. **Admission to the Programme:**

Admission to the Allied Health Sciences programmes shall be made in accordance with the terms and conditions as prescribed in Chapter 2 of the First Ordinance of SGT University, Gurgaon as amended from time to time.

i) Eligibility for Admission:

For admission to the 1st Semester of M.Sc. programmes, the candidate shall fulfil the following criteria:

Must have passed B.Sc. in any branch of Life Sciences / MLT / Zoology / B.Sc Biotechnology / B.Tech. Biotechnology/ B. Pharma and allied subjects

(ii) Schedule of admission and payment of fees:

The admission schedule, along with last date for submission of admission forms and payment of fees, shall be fixed by the Vice-Chancellor from time to time.

4. **Mode of Selection of Candidates for Admission:**

The admissions will be made as per the following criteria:

Sr. No.	Criteria	Condition
1	On the Basis of the Merit of the qualifying Examination.	If the no. of applicants is up to 3 times of the intake
2	On the Basis of the Merit of the Entrance Examination.	If the no. of applicants is more than 3 times of the intake

5. **Scheme of Examinations, distribution of marks, credit system and syllabus:**

The Scheme of Examinations, distribution of marks in various papers along with the credit system and the syllabi of the M.Sc. programmes shall be as approved the by Board of Studies/ Academic Council from time to time.(Scheme of Examination attached)

6. **Medium of Instruction:**

The medium of instruction and examination shall be English for all the programmes.

7. **Attendance Requirements/Eligibility to Appear in Examination:**

The student should fulfill the following criteria to be eligible for appearing in the End Term Semester Examination:

(i) He/She should bear a good moral character.
(ii) He/She should be on the rolls of the Faculty during the semester.
(iii) He/She should have 75% of the attendance during the respective semester.
(iv) The deficiency in the attendance, both in theory and practicals may be condoned by the Dean/ Director of the Faculty up to 5%.
(v) The deficiency may be further condoned by the Vice Chancellor in cases of exigencies/ extreme circumstances.
(vi) The student, who does not fulfil the condition laid down under (iii) to (v) above taken in aggregate may be allowed to appear only in the subject in which he/she fulfils the condition as per the sub clause (iii) to (v) above.
(vii) He/she should not be a defaulter in payment of any dues of the SGT University and no disciplinary action is pending against the student.

(viii) He/she should not be a defaulter in payment of any dues of the SGT University and no disciplinary action is pending against the student.

8. **Exemption from Attendance / Shortage of attendance to be condoned:**

The relaxation in shortage of attendance shall be given as per the following rules:

Sr. No	Exemptible No. of Lecture	Ground of Exemption	Competent Authority
1	All periods of the day of donation	Voluntarily blood donation to the Blood Bank.	Dean of the Faculty
2	All periods of the day of Examination	For appearing in the supplementary examinations (Theory/ Practical/ Viva-voce)	-do-
3	10 days attendance during a semester	For participation in University programmes/ University or Inter-Collegiate Sports Tournaments/ Youth Festivals, Cultural events/NCC/ NSS Camps/ University Educational Excursions/ Mountaineering Programmes	-do-
4	15 days attendance during a semester	For participation in Inter-University Sports Tournaments/ Youth Festivals	-do-

Provided:

(i) that he/she has obtained prior approval of the Dean, Faculty of Allied Health Sciences;

(ii) that credit may be given only for the days on which lectures were delivered or tutorials or practical work done during the period of participation in the aforesaid events.

9. **Attendance Shortage Warning:**

Attendance shortage warning will be displayed on the Faculty's Notice Board and/or University Website regularly.

10. Detained students:

If a student does not fulfill the condition of 75% attendance in any semester as per clauses 7-8, he/she will not be eligible for appearing in the End Term Examination accordingly and will be deemed to have been detained in the concerned paper(s). Such students will attend the classes with the regular students of the subsequent batch or he/she will make up the deficiency in attendance in accordance with the arrangement made by the Dean of the faculty to fulfill prescribed conditions to appear in the concerned examination of the programme/ paper as per clause 7 and clause 17.

11. Submission of Examination Forms and Payment of Examination Fee:

The Dean, Faculty of Allied Health Sciences shall submit the examination admission forms of those students who satisfy the eligibility criteria to appear in the examinations along with the prescribed examination fee to the Controller of Examinations as per schedule of examination circulated by the Controller of examinations from time to time.

12. University Examinations:

(i) End Term Semester Examinations:

The examination for the 1st and 3rd semesters (Odd Semesters) shall ordinarily be held in the month of December and of the 2nd and 4thsemesters (Even Semesters) in the month of May/June.

(ii) Fail/ Reappear candidates:

Fail / re-appear candidate of the odd semesters (1st& 3rd) will take re-appear exams as an ex-student in the subsequent exams of the odd semesters (1st & 3rd). Similarly, for the even semesters (2nd & 4th), he/she will take re-appear exams in the subsequent exams of the even semesters (2nd&4th). However, a candidate appearing in the 4thsemester examination (Regular) may appear simultaneously in his/her re-appear paper(s) of lower semesters. The student who fails in the 4th semester examination may appear in the subsequent examination along with the previous papers, if any, whether of odd/even semester.

(iii) Improvement Examination:

After passing all the semesters, a student may appear as an ex-student for improvement of his CGPA for the following purpose:

(i) Improvement of CGPA equal to 2nd division.

(ii) Improvement of the CGPA equal to 55% (aggregate of all the semester)

(iii) Improvement of CGPA equal to 1st division.

(a) For improvement, only one chance for each semester will be given within a period of two years of initially passing of the final examination.

(b) If a candidate appears for improvement and the status/nature of his/her final result does not improve his/her improvement result will be declared "PRS" (Previous Result Stands).

(c) The candidate shall be allowed to appear in the improvement examination(s) along with regular candidates as and when the programme is offered. No separate examination will be held for improvement of division/grade. In case of change of syllabi, the student shall have to appear for improvement in accordance with the changed syllabi of the concerned programme applicable to the regular students of that exam.

13. Distribution of Marks:

The distribution of marks shall be as prescribed in the Scheme of Examinations approved by the Board of Studies/Academic Council of the University.

14. Setting of Question Papers:

(i) The Dean of the Faculty shall supply the panel of internal and external examiners duly approved by the Board of Studies to the Controller of Examinations. The paper(s) will be set by the examiner(s) nominated by the Vice-Chancellor from the panel of examiners. Internal question bank will also be created and submitted to the controller of examination sticking to the domain of syllabus for use in regular and supplementary examination.

(ii) The question paper will be moderated by committee who are proficient in the subject in the office of controller of examination. The moderation will be done to see the difficulty level and that no question is out of syllabus & there is no mistake in the questions and the committee will amend/correct the paper accordingly.

(iii) The examiner(s) will set the question papers as per criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council of the University.

(iv) The examiner(s) will set the question papers as per criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council of the University.

15. Appointment of Examiners:

The examiners will be appointed as per the following guidelines with the approval of the Vice-Chancellor:

(i) An internal/external examiner should be of the level of an Assistant Professor/consultant/equivalent or above in the respective subject in a University/Institute/College/hospitals with a minimum experience of 02 years.
(ii) One external and one internal examiner will jointly conduct the practical examination.
(iii) External examiners shall not be from the same University and should preferably be from outside the State/University.
(iv) External examiners shall rotate at an interval of 3 years.

16. Evaluation Process – Theory, Practical, project & Internal Assessment Exams:

(A) Evaluation of Answer Books:

The answer books may be evaluated either by the paper setter or any other internal or external examiner to be nominated by the Controller of Examiners with the approval of the Vice-Chancellor from the panel of examiners approved by the Board of Studies.

(B) Re-evaluation of Answer Books:

Re-evaluation/ rechecking of any paper is allowed. The students can apply for Re-evaluation/ Re-checking of any paper through the HoD/ Dean of the Faculty within 10 days of the declaration of the result by paying prescribed fee.

(C) Internal Assessment: (as per university guidelines)

(i) Theory Paper: The internal assessment marks shall be assigned to each theory paper as per scheme of examination which shall be awarded as per the criteria given below:

Distribution of marks (e.g. 40)**:**

1	**Assignment**	**5 marks**
2	**Mid Term Test(10 Marks Each)**	**20 Marks**
3	**Synergy/Project**	**10 marks**
4	**Attendance**	**5 marks**
	Marks distribution for Attendance in % age	
	95<= attendance=100	**5 Marks**
	90<= Attendance<=95	**4 Marks**
	85<= Attendance<=90	**3 Marks**
	80<= Attendance<=85	**2 Marks**
	75<= Attendance<=80	**1 Marks**

(ii) Practical paper: The Internal Assessment for practical paper shall be awarded as per the criteria given below:

Distribution of marks (e.g. 20)**:**

1	**Attendance**	**5 marks**
2	**Practical/Project File/Dissertation**	**5 Marks**
3	**Internal Viva-Voce**	**10 marks**
4	**Marks Distribution for Attendance in % age**	

	95<= attendance=100	**5 Marks**
	90<= Attendance<=95	**4 Marks**
	85<= Attendance<=90	**3 Marks**
	80<= Attendance<=85	**2 Marks**
	75<= Attendance<=80	**1 Marks**

iii) Project/ Dissertation The Internal Assessment for project/ dissertation shall be awarded as per the criteria given below:
Distribution of marks (e.g. 60)**:**

(a) Attendance = 25% marks (e.g. 15 out of total 60 marks)
(b) Project file/ Dissertation= 25% marks (e.g. 15 out of total 60 marks)
(c) Internal Viva Voce = 50 % marks (e.g. 30 out of total 60 marks)

(iv) In case of ex-students, those appearing for re-appear/ improvement examination, their previous Internal Assessment marks will be counted or they may be reassessed if they so desire, but this relief will be for one time only and he will be **assessed for the marks on account of Mid Term Test and Assignment and his assessment on account of Attendance/Synergy et**c.. will stand same as before. If his internal assessment does not improve, previous internal assessment will be counted.

(v) The concerned teacher shall preserve records on the basis of which the Internal Assessment has been awarded and shall make the same available to the Controller of Examinations whenever required.

(vi) The Head of the Department/ Dean of the Faculty shall ensure that the internal assessment marks are submitted to the Controller of Examinations as per schedule circulated by Controller of Examination.

(D) Practical Examinations:

(i) **Appointment of Examiner:**

(1) The practical examinations shall be conducted by a Board of two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies.

(2) **Distribution of marks in examination of the practical paper will be as per the criteria given below:**

(a) **Practical Examination (Conduction/Demonstration)/ Project file/Dissertation = 50% marks (e.g.15 marks out of total 30 marks.**

(b) Viva-Voce in End Term Examination by External Experts = 50% marks (e.g. 15 marks out of total 30 marks)

(ii) Comprehensive Viva-Voce:

The comprehensive Viva-Voce for Project/dissertation shall be conducted by a Board of Two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies. Evaluation of the Project Report /Dissertation will be done by the External examiner.

(E) Evaluation of Project:

(i**) Topic and Appointment of Guide/Supervisor**

Each student who opts for a Research Paper /Project Report etc. will be assigned a Teacher as Guide/ Supervisor from the Faculty of Allied Health Sciences. Topic of the Research Paper/ Project Report will be as approved by the Dean of the Faculty on the recommendation of the Teacher Guide/Supervisor.

(ii) **Evaluation /Viva Voce:**

The student will submit the Project Report in the form of Dissertation on completion of the 4thsemester but 15 days before the commencement of examination failing which it will be acceptable only with late fee of Rs. 1000/-.. It will be got evaluated in accordance with above mentioned 16D (ii).

17. Criteria for Promotion to Higher Semester:

(i) **The student will be promoted to the next semesters irrespective of the no. of papers cleared/passed in the lower semesters.** But he/she will not be allowed to appear in the examination of the 4th Semester unless he/she has cleared 50% subjects of 1st and 2nd Semester taken together.

(ii) If the student fails in either theory or practical papers, he/she will have to re-appear only for the papers in which he/she has failed.

18. Credit Based Grading System:

(i) Grading Method

The grading system will be adopted on a 10 point scale. The grades will be awarded based on marks out of 100 and will be converted into grades as under:

S. No.	Range of Percentage of Marks	Letter Grade Value (Corresponding performance)	Grade Points	Range of Grade Points	Classification
1	90% and above	O (Outstanding)	10	9-10	Outstanding
2	80% or above but less than 90%	A+ (Excellent)	9	8<9	Excellent
3	70% or above but less than 80%	A (Very Good)	8	7<8	1st Div. with Distinction
4	60% or above but less than 70%	B+ (Good)	7	6<7	1st Division
5	50% or above but less than 60%	B (Above Average)	6	5<6	2nd Division
6	40% or above but less than 50%	C (Average)	5	Above 4<6	3rd Division
7	40%	P (Pass)	4	4	Pass
8	Below 40%	F (Fail)	0	-	-

Grade 'F' student may re-appear in that paper in the subsequent examination for that semester

(ii) Calculation of SGPA & CGPA

The performance of a student shall be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. The SGPA is calculated on the basis of grades obtained in pass grades in the semester:

$$SGPA = \frac{\Sigma \cdot (C \times G) \text{ for programme with at-least pass grade in a particular semester.}}{\Sigma \cdot (C) \text{ for each semester}}$$

Where C is number of credits of a programme as per study scheme of the program
G is Grade point obtained in that particular programme

The CGPA is calculated on the basis of all pass grades, except audit programmes, obtained in all completed semesters.

$$CGPA = \frac{\Sigma \cdot (C \times G) \text{ for programme with minimum pass grade in all completed semesters.}}{\Sigma \cdot (C) \text{ for all completed semesters}}$$

Where C and G shall have the meanings as given above

19. Pass criteria and grading system:

The minimum percentage of marks to pass the examination will be 40% in theory examination and practical examination separately (including internal assessment).

20. Declaration of Results:

(i) As soon as possible, after the semester examinations are over, the Controller of Examinations shall publish the results of those students who had appeared in the examinations.

(ii) Each successful student/ the student placed in reappear shall receive a copy of the Detailed Marks Certificate/ Grade Card Sheet of each semester examination.

(iii) The student whose result is declared late without any fault on his/her part may attend classes for the next higher semester provisionally at his /her own risk and responsibility, subject to his /her passing the concerned semester examination. In case, the student fails to pass the concerned semester examination, he/she will be governed by the clause 16 & 17 of these regulations.

21. Classification of Performance:

The successful students after the 4th semester examination shall be placed classified in five divisions on the basis of final CGPA obtained by him / her in the 1st to 4thsemester examinations as under:

CGPA	Classification of Performance
Those who obtain CGPA of 8.25 or more	First Division with Distinction
Those who obtain CGPA of 6.75 or more but less than 8.25	First Division
Those who obtain CGPA of 5.75 or more but less than 6.75	Second Division
Those who obtain CGPA above Pass Grade but less than 5.75	Third Division
Those who obtain CGPA less than Pass Grade	Fail

22. Grace Marks:

Maximum 1% of total marks excluding internal assessment marks can be awarded to a student in one academic year.

23. Clinical Training

All the candidates shall complete the recommended hours (Given in scheme of examination) in Clinical Training during the programme. All the students shall go for the compulsory rotatory hospital training each year as approved by the Board of Studies in parent Institution/Hospital. Internship, wherever applicable, will be carried out at the parent Faculty/hospital of Shree Guru Govind Singh Tricentenary (*SGT)* University. The students may be permitted to undergo internship training for not more than six months (50% of total period of internship) in the hospitals empaneled by the SGT University for this purpose or the hospitals approved by MCI/DNB.

24. Other Provisions:

i) Nothing in the Ordinance shall debar the University from amending the Ordinance and the same shall be applicable to all the students whether old or new.

ii) Any other provision not contained in the Ordinance shall be governed by the rules and regulations framed by the University from time to time.

iii) In case of any interpretation, The Vice-Chancellor is empowered in this regard and his interpretation shall be the final.

iv) Notwithstanding the integrated nature of this programme which is spread over more than one academic year, the Ordinance in force at the time a student joins the programme shall hold good only for the examination held during or at the end of the academic year.

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M.Sc Molecular Biology And Molecular Diagnosis

Semester I								
Paper	**Subject**	**Paper Code**	**Theory Examination**		**Practical Examination**		**Total Marks**	**Credits**
			Univ. Exam.	**Int. Assess-ment**	**Univ. Exa**	**Int. Assess-ment**		
1	Fundamentals of Molecular Biology	05470101	60	40	-	-	100	4
2	Biochemistry and Enzymology	05470102	60	40	-	-	100	4
3	Tools and Techniques in Molecular Biology & Biochemistry	05470103	60	40	-	-	100	4
4	Bacteriology	05470104	60	40	-	-	100	4
5	Research Methodology And Biostatistics	05470105	60	40	-	-	100	4
6	Critical Research Appraisal	05470106	-	-		50	50	2
7	Practical I (Molecular biology & Biochemistry)	05470107	-	-	20	30	50	2
8	Practical II (Bacteriology)	05470108	-	-	20	30	50	2
	Total		**300**	**200**	**40**	**110**	**650**	**26**
Semester II								
9	Clinical Biochemistry	05470201	60	40	-	-	100	4
10	Gene expression and Molecular cell biology	05470202	60	40	-	-	100	4
11	Immunology and Immunodiagnostics	05470203	60	40	-	-	100	4
12	Medical Genetics	05470204	60	40	-	-	100	4
13	Omics based diagnosis	05470205	60	40	-	-	100	4
14	Project Development & Seminar	05470206	-	-		50	50	2
15	Practical III (Clinical Biochemistry & Immunology)	05470207	-	-	20	30	50	2

16	Practical IV (Gene expression and molecular cell biology, and Medical genetics)	05470208	-	-	20	30	50	2
	Total		**300**	**200**	**40**	**110**	**650**	**26**
Semester III								
17	Virology and Mycology	05470301	60	40	-	-	100	4
18	Molecular Diagnosis & Recombinant DNA technology	05470302	60	40	-	-	100	4
19	Bioinformatics and medical diagnosis	05470303	60	40	-	-	100	4
20	Clinical Pathology	05470304	60	40	-	-	100	4
21	Technical Writing & Seminar	05470305	-	-	40	60	100	4
22	Evaluative Clinical Training	05470306	-	-	40	60	100	4
23	Practical V (clinical pathology)	05470307	-	-	20	30	50	2
24	Practical VI (Recombinant DNA technology & Virology and Mycology)	05470308	-	-	20	30	50	2
	TOTAL		**240**	**160**	**120**	**180**	**700**	**28**
Semester IV								
25	Project & Dissertation	05470401			120	180	300	12
26	Quality control & Laboratory Safety	05470402	60	40			100	4
	TOTAL		**60**	**40**	**200**	**100**	**400**	**16**

Total Credits : 96

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470101: Fundamentals of Molecular Biology

COURSE OBJECTIVES: The purpose of this course is to introduce the student to the advanced concepts in molecular biology. Student will gain an understanding of molecular mechanisms of DNA replication, DNA repair, transcription, translation, and gene regulation in prokaryotic and eukaryotic organisms

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-I Structure and Functions of Nucleic Acids:

The beginning of Molecular Biology; DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, biologically important nucleotides, Watson-Crick model, Supercoiled DNA, structure of different types of nucleic acids, hydrolysis of nucleic acids. Conformation of nucleic acids: A-, B-, Z- t-RNA, Stability of nucleic acid structure

Unit-II DNA replication and repair

Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, DNA damage and repair mechanisms.

Unit III: RNA synthesis and processing:

Structure and function of RNA polymerases. Transportation in prokaryotes Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit-IV: Protein synthesis and processing:

Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, posttranslational modification of proteins.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470102: Biochemistry & Enzymology

COURSE OBJECTIVES: At the end of the course, the student should be able to understand the various biochemical pathways involved in propagation of life, understand the working of enzymes as biocatalysts and use of enzymes-based technology.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-I: Carbohydrates and Lipids

Carbohydrates: Definition importance, classification, and functions, Glycosidic bonds, Carbohydrate metabolism- Glycolysis and its regulations, Gluconeogenesis, Tricarboxylic acid cycle and their regulation, Cori cycle, Hexose monophosphate shunt, Glycogen metabolism and its regulations, Glucose Alanine cycle.

Lipids: Structure of fatty acids, Classification of lipids, essential fatty acids, Structure and functions of major lipids, subclasses- Acylglycerols, Phospholipids, Glycolipids, lipoproteins, Sphingholipids, Fatty acids: oxidation, synthesis and regulations.

Unit-II: Proteins and Nucleic acids

Proteins: Definition, importance and functions, amino acids as building blocks of proteins, essential amino acids, non-protein amino acids, structure of peptide bond, organizational levels of protein structure, protein denaturing and renaturing, Role of chaperons in protein folding, protein classification, Conformation of proteins: Ramachandran Plot, Secondary, tertiary and quaternary structure; domains; motif and folds. Stabilizing interactions: Vander waals, electrostatic, hydrogen bonding, Hydrophobic interactions.

Nucleic acids: Structure and properties of nucleic acid bases, nucleosides and nucleotides, Biosynthesis and degradation of purines and pyrimidines and their regulation. Biosynthesis of ribonucleotides, deoxyribonucleotides and inhibitors of nucleotide biosynthesis.

Unit-III: Introduction to Enzymes & Enzyme Kinetics

Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group, Nature of active site, Activation energy, Lock and Key Model, Induced fit Theory, Enzyme activity, Specific enzyme activity, Turnover number, Factors affecting enzyme activity. Michaelis Menten equation. Derivation of Michaelis Menten equation and determination of Km and Vmax values, Lineweaver-Burk plot, Hanes Wolff Plot, Eadie-Hofstee Plot, Enzyme inhibition: reversible and irreversible inhibition, Suicide inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Allosteric enzymes, Sigmoidal behavior, Isozymes and their importance,

Unit IV: **Enzyme Technology**:

Enzymes as analytical reagents, Immobilized enzymes, RNA molecules as enzymes, Abzymes and their applications, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470103: Tools and Techniques in Molecular Biology & Biochemistry

COURSE OBJECTIVES: At the end of the course, the student should be able to understand the molecular biology and biochemistry techniques that are used to diagnose various diseases

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-I : Nucleic acid extraction

Isolation of nucleic acids, Extraction of genomic DNA & plasmid DNA by boiling lysis method, alkaline lysis method, by Kit methods, RNA extraction, Qualitative and quantitative estimation of DNA & RNA.

Unit II: Polymerase Chain Reaction

Polymerase chain reaction, Nested PCR, Colony PCR, Assembly PCR, touchdown PCR, multiplex PCR, Hot start PCR, Methylation specific PCR, LAMP Assay, Methods for synthesis of double strand cDNA, RT PCR and Real Time PCR, DNA sequencing by Maxum Gilbert method and Sanger's dideoxynucleotide method, RFLP, RAPD

Unit-III: Protein purification techniques

Salting in, Sating out, Dialysis, Chromatography: Principles of chromatography, Paper chromatography, Thin Layer Chromatography, Gel filtration Chromatography, Ion exchange Chromatography, Affinity chromatography, Hydrophobic interaction, Reverse-phase chromatography, HPLC, Gas chromatography

Unit IV: Spectroscopic Techniques, Electrophoresis and Blotting

Lambert Beer's Law, Analysis of biomolecules using UV/visible spectrophotometer, fluorescence, circular dichroism. Electrophoresis, types of electrophoresis. Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Isoelectric focusing, Southern Blotting, Northern Blotting and western Blotting

Unit V: Tissue Culture Techniques

Animal cell culture, Cell lines, Primary cells, Culture media and environment, Subculturing, Subculturing adherent cells, Subculturing suspension cells, Freezing cells, Thawing frozen cells, Transfection

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470104: Bacteriology

COURSE OBJECTIVES: The purpose of this course is to understand students about the scope and development of microbiology, to learn the cultural techniques and pathogenesis of various clinically important microorganisms

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I :

History and Pioneers in Microbiology, Bacterial Taxonomy: Nomenclature and classification of microbes, Microscopy, Stained preparation, Size & Shape and arrangement , Morphology of bacteria: Structures of a bacterial cell and their functions Physiology of Bacteria: Nutrition, Gaseous requirement, temperature requirement and other growth requirements.

Unit II:

Sterilization and Disinfection , Culture media and Culture methods. Bacterial genetics, Biochemical Identification of Bacteria. Antimicrobial agents, Antibiotic sensitivity testing, : Mechanism of Actions , Antimicrobial resistance. Typing methods of bacteria. Epidemiology of infectious diseases, Normal human microbiota and their role.

Unit III

• Morphology, Cultural Characteristics, Pathogenesis , Laboratory Diagnosis of following bacteria: • Staphylococcus, Streptococcus including Pneumococcus, Neisseria, Micrococcus, Bacillus, Corynebacterium, Clostridium. • Enterobacteriaceae, Vibrios, Pseudomonas, Brucella, Haemophilus, Bordetella • Spirochaetes, • Chlamydiae, Rickettsiae. • Mycobacteria • Lactobacillus, , Bacteroides, Fusobacterium , Actinomycetes, Ureaplasma, Actinomycets, Nocardia,

Unit-IV

Opportunistic infections, Laboratory and hospital acquired infections. Vector borne infections, Zoonotic infections. Emerging and re-emerging infections. Transfusion transmitted infections. Laboratory diagnosis of urogenital infections, respiratory tract infections, gastrointestinal infections, central nervous system infections, skin and soft tissue infections. Hospital infection control.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470105: RESEARCH METHODOLOGY AND BIOSTATISTICS

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

UNIT-I Introduction and Some Basic Concepts: Sample and population. Statistical definitions. Random sampling. Testing of hypothesis. Statistical tools for collection, presentation and analysis of data relating to causes and incidence of diseases. Measurement of central tendency. Measures of variation. Frequency distribution.

UNIT-II Concept of Probability: Laws of Probability. Probability Distribution Binomial, Normal and Chi-square distribution Commonly used procedures and test of significance and estimation Correlation and regression Test of significance namely Z test, T test, Chi square test, F test Analysis of variance.

UNIT-III Research Statistics: Research Statistics pertaining to medical laboratory technology Testing the efficacy of manufacturing drugs Medicines and injections for curbing and controlling specific diseases Statistical analysis of instrumental data and comparison of various biological techniques used in hospitals.

UNIT-IV Health care – an overview: Functions of Hospital administration Modern techniques in Hospital management Challenges and strategies of Hospital management Administrative Functions– Planning, Organizing, Staffing, Leading and Controlling Organizational Structure, Motivation and leadership. Designing health care organization.

Hospital Management: Medical record, House-keeping services. Laboratory performance. Management of biomedical waste.

Total patient care – indoor and outdoor. Nursing and ambulance resources, Evaluation of hospital services. Quality assurance.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470106: CRITICAL RESEARCH APPRAISAL

(REPORT SUBMISSION)

The student is expected to read and critically evaluate minimum of 5 papers and present the inference of every part in a clear and precise manner in the form of a report and short seminar at the end of semester based on which the student will be evaluated.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470107: Practical I (Molecular Biology & Biochemistry)

- Test for Carbohydrates
- Test for proteins
- Test for lipids
- Validation of Lambert's and Beer's law and derivation of standard curve in colorimetry
- Determination of unknown concentration of coloured solutions by photometric method
- Assay of acid phosphatase in crude potato extract
- Quantitative estimation of DNA and protein by using spectrophotometry
- Separation of analytes by performing paper & thin layer chromatography
- Extraction of DNA by Boiling Lysis methods
- Extraction of DNA by Alkaline Lysis methods
- Extraction of DNA by kit methods
- Quantitative estimation of DNA & Quality check of DNA by agarose gel electrophoresis
- Polyacrylamide gel electrophoresis of serum proteins.
- Determination of molecular weight of a protein by SDS-PAGE.
- Separation of compounds/ proteins based on specificity - Affinity Chromatography.
- Separation of compounds based on charge - Ion-Exchange chromatography.
- Separation of compounds based on size - Gel permeation chromatography

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER I

05470108: Practical II (Bacteriology)

- Aseptic practices in laboratory and safety precautions
- Staining methods : Gram stain, Alberts, ZN stain, capsular stain , motility testing
- Preparation and pouring of media – Nutrient agar, Blood agar, Mac Conkey agar, Sugars, Serum sugars, TSI, Robertsons cooked meat, Lowenstein Jensens, Sabouraud dextrose Agar
- Culture Methods
- Biochemical test for identification of bacteria
- Antibiotics sensitive test
- Biomedical waste management
- Disposable of clinical samples
- Sterilization and disinfection
- Care and operation of Microscopes viz. Light and Fluorescent microscopes.
- Methods for the preservation of bacteria, Maintenance of stock cultures.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470201: Clinical Biochemistry

COURSE OBJECTIVES: The purpose of this course is to familiarize students with molecular basis of most prevalent diseases and to understand analytical methods commonly used in the clinical laboratory which are applied to medical diagnosis, treatment and management of diseases

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I:

Introduction of Clinical Biochemistry: Introduction & importance of clinical biochemistry in diagnosis. Methods of taking blood specimen, Separating the serum and plasma aseptically. Anticoagulants, Major classes of Plasma proteins, Synthesis of Plasma proteins, Function of Plasma Proteins, Separation of Plasma Protein. Integration of Metabolism at Cellular and Tissue or Organ Level. Blood glucose regulation. Metabolism in Starvation, Phases of Starvation and Diabetes

Unit II: Acid-Base balance & Metabolism: - Distribution of water and electrolytes in the body, Water and electrolytes balance ,Buffers of body fluids, respiratory regulation of pH, renal regulation of pH, disturbances in acid-base balance- metabolic acidosis, metabolic alkalosis. Respiratory acidosis & alkalosis, anion gap, determination of blood pH & gases. Metabolism of Calcium, Phosphorus, Sulfur etc. Metabolism of Trace elements. Bone metabolism

Unit III: Disorders of Metabolism:

Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia, lactose intolerance, and lactic acidosis. Disorders of lipids: lipid mal-absorption and steatorrhea, sphingolipidosis, clinical interrelationships of lipids, lipoproteins and apolipoproteins. Disorders of amino acid metabolism: inborn errors of amino acid metabolism-alkaptonuria, phenylketouria, albinism, gout, hyperglycemia, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias. Disorders of nucleic acid metabolism (Purine and Pyrimidine metabolism), Disorders of iron, porphyrin and mineral metabolism. Metabolism under stress conditions.

Unit IV: Clinical enzymology & biomarkers: – Principles of clinical enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine aminotransferase, plasma lipid profile, hypolipoproteinemias, hyperlipidemias. Cardiac markers-creatine kinase (CK-MB), cardiac troponins, high sensitive TnT, AST & LDH. Markers of Muscle diseases-creatine kinase (CK-MM), aldolase. Markers of bone disease- Alkaline phosphatase, heat labile bone isoenzymes. Prostate markers- prostate specific antigen, acid phosphatase. Miscellaneous enzymes-Glucose-6-phosphate dehydrogenase, urease, glucose oxidase & peroxidase. test based on serum enzymes-serum enzymes as markers of hepatobiliary disease, markers of obstructive liver disease, Test to assess renal function-glomerular filtration rate, clearance tests, glomerular permeability, proteinuria, assessment of tubular function- reabsorption studies, secretion test, concentration and dilution test, renal acidification. Uric acid excretion

Unit V: Automation: - Introduction of automation, continuous flow analyzers, semi-automated analyzers, fully-automated analyzers.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470202: Gene expression & Molecular Cell Biology

COURSE OBJECTIVES: The purpose of this course is to provide insights of various signalling cascades and their regulation; and provides a comprehensive understanding of various genetic aspects and impact of their mutations on cellular physiology and outcome.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-I : Molecular Biology of Cell cycle:

Eukaryotic and prokaryotic cells, subcellular organelle and their functions. Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Regulation of Cell cycle progression: Maturation promoting factors (MPF), Cyclins and Cyclins dependent kinases, growth factors and growth inhibitory factors. Cell death and apoptosis.

UNIT II : Cancer

Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth.

Unit-II : Control of Gene Expression at transcription and translation level in Prokaryotes & Eukaryotes

Constitutive, Inducible and Repressible gene expression, Positive and Negative control of gene expression, Lac, Tryptophan, arabinose operons; Concept of attenuation, Lytic cascade and lysogenic repression in lambda bacteriophage. Eukaroytic genome organization, Proteins involved in the control of transcription, Protein, protein interactions, Post-translational control, DNA methylation, Cell Signaling, Ligand binding to membrane receptors and its role in regulating transcription, phosphorylation cascade and amplification of signal. Role of chromatin in regulating gene expression.

Unit IV: Gene Editing

Gene silencing, RNA interference and its significance. microRNAs, siRNA, shRNA and their significance Approaches to analyze differential expression of genes; Gene tagging; Gene trapping; Knockout mutants; Knock in and Knock down mutants, Crispr-Cas 9 technology

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470203: Immunology and Immunodiagnostics

COURSE OBJECTIVES: The purpose of this course is to understand students about the immune system, cells of immune system, different classes of antibodies and to learn various immunological techniques for the diagnosis of various diseases.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-l: introduction to Immunology:

Historical background, General concepts of the immune system, Innate and Adaptive immunity; Active and Passive immunity; Primary and Secondary immune response, Humoral and cell mediated immune response. Antigen, Haptens, Antibody and its Classification, B and T cells. Major Histocompatibility Complex (MHC): Role of MHC, Structure of MHC molecule, binding of peptides to MHC molecules, MHC restriction. Concepts of antibody diversity and class switching. (isotype, allotype and idiotype)

Unit II: Structure, properties and functions of the immune system

Hematopoeisis, T and B lymphocyte, NK cells, Monocytes and Macrophages; Neutrophils, Eosinophils, Basophils, Mast cells and Dendritic cells, Thymus and Bone marrow, Lymph nodes, Spleen, MALT, GALT and SALT, Pattern recognition receptors. Complement system: Components of the complement activation classical, alternative and lectin pathways, Biological consequence of complement activation, Methods to study complement fixation. Cell mediated immune response: T cell maturation in thymus, thymic selection, self MHC restriction of T cells, T cell receptor complex. T cell sub-types and their effector function. Trimolecular complex formation between APC and Naïve T cells, clonal expansion. Cytokines properties of Interferon and Interleukins (IL1, IL2, IL4).

Unit III: Dysfunctions of immune system and Vaccines

Types of hypersensitivity, Overview of autoimmunity. Immunodeficiency disorders: HIV/AIDS, Animal models of primary immunodeficiency (nude mouse and SCID mouse). Types of Vaccines (live attenuated vaccines, inactivated viral vaccine, subunit vaccine, recombinant viral vaccine, DNA Vaccines) and their characteristics, Adjuvants.

Unit-lV: lmmunodiagnostics:

Affinity and Avidity, Cross reactivity, Precipitation, Agglutination, antigen-antibody interaction, polyclonal and monoclonal antibodies, Radioimmunoassay (RIA), ELISA (enzyme-linked immunosorbent assay) and its types (direct, indirect, sandwich, competitive ELISA), ELISPOT, Chemiluminescent Immunoassay, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Flow cytometry, FISH, Fluorescence and immunoelectron microscopy, lmmunohistochemistry.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470204 : Medical Genetics

COURSE OBJECTIVES: The purpose of this course is to improves the understanding of the genetic basis for life and opens up new approaches for the investigation, diagnosis and treatment of disease.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit-I

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests.

Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit-II

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.

Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit-III

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Recombination: Homologous and non-homologous recombination, including transposition, site-specific recombination

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470205: Omics based Diagnosis

COURSE OBJECTIVES: The purpose of this course is to familiarize students with genome sequencing strategies, methods of assembly and comparative genomics and to attain basic principles involved in protein structure determination and correlating structure to function and to know the different application of genomics and proteomics in diagnosing diseases

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I : Genomics

Genomics: Physical structure and genetic content of Human genome, Nature of genetic variations: Single nucleotide polymorphism, Large scale variations, conserved and variable domains, Methods for studying variation: RFLPs, VNTR and minisatellites, SSCP and direct Sequencing. Genetic and physical maps of human genome: chromosome maps and markers, clone libraries and Expressed sequence Tag. Locating genes in DNA sequence, Determination of gene function, Role of genetic footprinting in assigning function of a gene, Patterns of gene expression.

Unit-II : Microarray

Human genome project DNA Chips and Microarray: Chemical DNA synthesis, Printing of oligonucleotides Genome analysis for global patterns of gene expression using fluorescent labeled cDNA or end-belled RNA probes, Analysis of single nucleotide polymorphism using DNA chips, Advantages and Disadvantages of DNA microarray.

Unit-III: lntroduction to Next-Generation Sequencing (NGS):

Next-Generation Sequencing platform. NGS based methods (ChlP-seq, Metagenomics. Epigenomics & Exome Sequencing). NGS Sequencing Depth and Coverage. Genome Mapping & Annotation. Genome Databases (UCSC, ENCODE, etc.). NGS Data analysis

Unit IV: Proteomics & its tools

Proteomics Introduction to proteomics, Techniques in proteomic diagnosis: Two dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy, Protein microarrays, Advantages and disadvantages of protein microarrays, Total expression vs functional proteomics, . Gene Ontology; Biological pathways database (KEGG); Pharmacogenomics, Introduction of metabolomics, Application of proteomics, Protein sequence-structure-function relationship, Techniques for solving protein structures - XRD, NMR, Mass spectroscopy – MALDI-TOF, ESI-MS, Tandem-MS, Protein-Protein Interaction, Library based methods - Phage interaction display and Yeast Two-Hybrid system, Protein-DNA interactions

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470206: PROJECT DEVELOPMENT & SEMINAR

In this semester the student is expected to work on finalising the topic and methodology with a detailed review of literature work to be submitted in the form of a synopsis along with a seminar to be held. Allotment of guide will also be carried out. It will involve a comprehensive literature survey of the chosen research area. Through regular meetings, the student and advisor discuss this literature in detail and the topic for research project

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470207: Practical III (Clinical Biochemistry & Immunology)

- Estimation of blood glucose by enzymatic method
- Estimation of glycosylated hemoglobin
- Estimation of Fibrinogen in plasma
- Prothrombin time.
- Lipid profile
- Determination of serum Creatine and Creatinine
- Determination of Uric acid in serum
- Determination of Urea in serum
- Determination of serum Bilirubin
- Determination of SGOT
- Determination of SGPT
- Determination of serum Alkaline Phosphatase
- Determination of serum Chlorides
- Determination of nature of antigen using Ouchterlony double immunodiffusion assay
- Quantification of Antigens by Radial Immunodiffusion
- Enzyme linked immunosorbant assay: HIV, HBsAg, HCV
- Determination of antibody concentration by ELISA
- Detection of antibodies in serum against *Salmonella* antigen by Widal test
- Separation of antibody in serum by immunoelectrophoresis
- Detection of protein by Western blotting
- Latex agglutination tests: RA, CRP

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER II

05470208: Practical IV (Gene expression and molecular cell biology, and Medical genetics)

- Quantitation of genomic DNA using Nanodrop method.
- How to perform total cell RNA isolation from eukaryotic cells.
- Quantitation of total RNA using Nanodrop method.
- Polymerase Chain Reaction (PCR) of genomic DNA and cDNA samples.
- Quantitative Real time PCR (qPCR) of genomic DNA and cDNA samples.
- Reverse Transcriptase PCR (RT-PCR).
- Multiplex qPCR for quantitation of gene expression and SNP detection.
- Eukaryotic cell total and gene specific cDNA synthesis.
- Expression of a genes at different temperatures
- Expression of genes with constitutive promoters
- Expression of genes with different concentrations of inducers
- Demonstration of microscopes
- Karyotyping
- Detection of biomarkers of pregnancy from amniotic fluid

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470301: Virology and Mycology

COURSE OBJECTIVES: The purpose of this course is to understand students about the viruses, their replication and pathogenesis of various diseases caused viruses.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I: Nature of Viruses & Viral replication:

Introduction of viruses, general properties, concept of viroids, virusoids, satellite viruses, prions, giant viruses, virophages. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. Isolation, purification and cultivation of viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses. Bacteriophages (T4 and lambda), lytic and lysogenic phages (lambda phage) concept of early and late proteins, : Interaction of viruses with cellular receptors and entry of viruses.

Unit II : Viral diseases, their prevention, diagnosis & treatment

Poliomyelitis, Influenza Viruses, Rubella, Mumps , Measles, Rota virus, Japanese encephalitis & Dengue, Chikungunya, Ebola, Zika, Nipah, Kyasanur Forest disease ,Human Onocogenic Viruses, HIV, Hepatitis virus, Herpesviridae, Human papilloma virus

Unit-III: Diagnosis and treatment

Types of interferons, antiviral drugs (Acyclovir, ganciclovir and AZT). Laboratory diagnosis of viral infections, Prevention and control by viral vectored based vaccines

Unit-IV : Introduction to fungus

Introduction and classification of fungi. Laboratory identification methods of Fungi. Fungi causes skin and superficial infections, fungi causing respiratory tract infections and central nervous sytem infections, fungi causing ocular and ear infections. Specimen collection of fungal infections, antifungal susceptibility testing.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470302: Molecular Diagnosis & Recombinant DNA Technology

COURSE OBJECTIVES: The purpose of this course is to understand students about the concepts of recombinant DNA technology and its application in genetic engineering.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I: Outlines of recombinant DNA technology:

Enzymes used in recombinant DNA technology, Restriction endonucleases, Type I-IV restriction endonucleases, nomenclature and sequence recognition, isochizomers, neoschizomers, blunt end and sticky ends, Joining of DNA molecules: role of DNA ligase enzymes, adaptors, linkers, homopolymer tailing.

Unit II: Cloning vectors

Plasmids, Cloning vectors (pUC vectors, T-vectors), Lambda phage-derived vectors (replacement and insertion vectors), Cosmids, in vitro packaging, BAC, YAC, Ti-plasmid, Cloning vectors for eukaryotic system, Expression vectors, Prokaryotic and Eukaryotic expression vectors, Shuttle vectors, Inducible and Constitutive expression.

Unit III: Cloning and expression of genes in Prokaryotic and Eukaryotic cells

Process of gene cloning, TA cloning, blunt-end cloning, staggered end cloning, Transformation, Transfection, Gene transfer techniques: Biological delivery systems - Agrobacterium tumefaciens, Retroviral systems, Artificial delivery systems - Gene gun, Microinjection, Lipofection, Electroporation, Ca - DNA coprecipitation, Selection (antibiotic selection) and Screening (blue/white & by colony PCR) of bacterial transformants. Expression and purification, Challenges in expression of foreign proteins in heterologous host. Promoters. Expression in eukaryotic cells, Fusion proteins and tags, Fusion and tagged protein cleavage system, Manipulations to improve the yield of recombinant protein.

Unit IV: Molecular diagnosis Techniques & Applications

Principle and applications of PCR, Primer-designing, different types of PCR: Hot start, Reverse transcription, Real time and multiplex PCR, cDNA, RACE PCR, DNA sequencing – Maxan Gilbert & Sanger Methods. DNA finger printing (RFLP, RAPD, AFLP), site directed mutagenesis, generation of deletions, chromosomal walking, chromosomal jumping, gene therapy, application of recombinant DNA technology in therapeutics and diagnosis, Importance and applications of Molecular diagnostics: Viral load monitoring, window period, diagnosis of various diseases: HIV type -1, HIV type II, HPV, Various hepatitis strains, Influenza (H1N1) and Mycobacterium tuberculosis

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470303: Bioinformatics and Medical Diagnosis

COURSE OBJECTIVES: The purpose of this course is to familiarize students about the concepts and applications of bioinformatics and to understand types of literature databases, nucleic acid databases, gene expression databases, RNA databases, genome databases, and protein databases; and their uses to understand to biology.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

UNIT 1: Biological Databases: Introduction; Types of databases in terms of biological information content; Protein and gene information resources; Specialized genomic resources; GenBank, EMBL, DDBJ, Pubmed, Different formats of molecular biology data.

UNIT 2: Sequence Alignment:

Local and global sequence alignments (Needleman-Wunsch and Smith-Waterman algorithms), pair-wise (BLAST and FASTA algorithms) and multiple sequence alignment (Clustal W) and its importance. Theory behind BLAST- how Hidden Markov Model (HMM), Alignment scoring matrices; scoring an alignment, substitution matrices .

UNIT 3: Molecular Phylogenetics: Concept of orthology, paralogy and homology in gene and protein sequences. Methods and tools for phylogenetic analysis; Creation, evaluation and interpretation of evolutionary trees; Advantages and disadvantages of phenetic and cladistic approaches.

UNIT 4: Protein Structure Databases and Applications :

Understanding structures from Protein Data Bank (PDB); Accessing and mining other protein structure classification databases such as SCOP, CATH; Tools for viewing and interpreting macromolecular structures e.g. DeepView, PyMol. , Ab-initio and homology based methods, Protein structure prediction : PSIPRED, PROSITE, Pfam, ExPasy. Concept and methods of homology modeling, threading and fold recognition;

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470304: CLINICAL PATHOLOGY

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I

Fetal and neonatal physiology and pediatric diseases : Growth and functional development of the fetus, adjustment of the infant to extrauterine life, special functional problem in the neonate, problems of prematurity, congenital anomalies, perinatal infections, syndromes of the new born, immune hydrops, tumours and tumour like lesions of infancy and childhood.

Cervical cancer, uterine and ovarian cancers, gestational trophoblastic neoplasia. Sexually transmitted diseases – syphilis, gonorrhoea, trichomoniasis, human papilloma virus infection. Diseases during pregnancy – placental inflammations and infections, ectopic pregnancies, gestational trophoblastic diseases and eclampsia.

Unit II

Red blood cells disorders : basic aspects of anemia - definition, pathophysiology, classification and clinical features. Investigation of anemia in general.

Microcytic hypochromic anemias: Iron deficiency anemia – iron metabolism, causes of iron deficiency, clinical features and laboratory investigation.

Macrocytic anaemias : Megaloblastic anaemia - etiology, clinical features, lab investigations. Non - megaloblastic anaemia. Pernicious anemia.

Normocytic normochromic anemia: anemia in systemic disorders, (acute blood loss, renal failure, liver disorders).

Disorders of haemoglobin : structure of haemoglobin and synthesis,normal and abnormal haemoglobins, haemoglobinopathies (thallesemia and sickle cell anemia).

Haemolytic anemias: definition, pathogenesis, classification, clinical features, lab investigation.

Aplastic anemia: pancytopenia.

Polycythemia – classification, clinical features and lab investigation.

Unit III

WBC disorders: Leukamoid reaction, myelodysplastic syndrome (MDS) – definition, clinical features, peripheral smear and bone marrow findings.

Leukemias : definition, classification – FAB and WHO of acute leukemias, diagnostic criteria, cytochemicalstaining and immunophenotyping.

Chronic leukemia: classification, diagnostic criteria, clinical feature and lab investigation.

Myeloproliferative disorders: classification, clinical features, lab investigations, chronic myeloid leukemia in detail.

Lymphoproliferative disorders : chronic lymphocytic leukemia in detail.

Plasma cell disorders: classification. Plasma cell myeloma – definition, clinical features, lab investigations.

Unit IV

Hemorrhagic disorders: definition, pathogenesis, clinical features and classification of vascular, platelet disorders, coagulation disorders and fibrinolysis.

Platelet disorders: quantitative- thrombocytopenia, ITP – classification, clinical featuresand bone marrow findings in ITP. Qualitative platelet disorders - thrombocytosis- definition, etiology and lab investigations.

Coagulation disorders inherited : Haemophilia A & B, Von – Willebrand's disease, acquired vitamin K deficiency, liver diseases, DIC Investigations of haemorrhagic disorders: tests of vascular and platelet function – bleeding time, clotting time, platelet count, platelet aggregation studies.

Test for coagulation disorders: screening tests (first line tests) – prothrombin time, activated thromboplastin time (APTT), thrombin time. Second line test: coagulation factors assay, urea solubility test for factor XIII, factor VIII, inhibitor study, fibrinogen assay.

Thrombotic disorders: classification- inherited and acquired. Clinical features, investigations of thrombotic disorders (protein C, protein S, PT-III, Factor V)

Antiphospholipid antibody syndrome- definition, clinical features, lab investigation.

Bone marrow examination- aspiration and Trephine biopsy and staining

Automation in hematology

Unit V

Collection, transport, preservation and processing of various clinical specimens. Urine examination – physical, chemical andmicroscopic urine analysis by Strip method. Body fluids: CSF – specimen collection, normal composition and clinical significance, routine examination (physical and cytological examination)

Other fluids: pleural, pericardial and peritoneal fluids, synovial and gastric fluids - Brief description with routine examination

Semen analysis and pregnancy test.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470305: TECHNICAL WRITING & SEMINAR

In this semester the student will start working on their research proposal and evaluate the outcome of the project along with a detailed seminar presentation on progress made. Each student must submit to the university with the signed approval of the advisor, a thesis proposal defining the thesis project, the methods and design of the experiments needed for completion, the progress to date and plans for completion in the fourth semester.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470306: Evaluative Clinical Training

In this semester the student will be marked on the basis of knowledge and hands on training carried out during their postings of 45 days to various institutes/hospitals. Each student must submit the work report carried by him/her to the university .

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470307 : Practical V (clinical pathology)

- Basic staining used for fungi : KOH preparation and LPCB
- Culture methods and growth identification
- Slide culture techniques
- Collection of clinical specimen
- Laboratory identification of Candida species
- Rapid card test
- ELISA for viral disease
- Coomb's test (direct and indirect)
- Urine : microscopic examination and automation in urine analysis
- Reticulocyte count: preparation, staining examination and corrected retic count.
- Semen analysis: microscopic examination and methylene blue staining for morphology
- Pregnancy test
- Body fluid analysis (CSF, pleural and peritoneal/ascetic fluid)- physical, chemical and microscopic examination
- Sickling test for sickle cell anemia
- Osmotic fragility test
- LE cell preparation and examination
- PT and APTT test
- BT/CT with clot lysis and clot retraction time
- Automation in urine analysis

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER III

05470308: Practical VI (Recombinant DNA technology & Virology and Mycology)

- Construction of restriction map using restriction enzymes
- Primer designing
- Amplification of DNA using specific primers by PCR
- Restriction digestion of suitable vector
- Ligation of restricted DNA fragments
- Preparation of competent *E.coli* cells,
- Performing transformation of E.coli cells with recombinant construct
- Selecting the recombinants
- Blue white screening
- To study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs/photographs
- To study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs/photographs

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER IV

05470401: Project & DISSERTATION

After completion of dissertation lab work, this involves preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The student should submit a draft of the thesis along with a manuscript draft (submitted or prepared for publication in Scopus indexed Journal) to the advisor by the end of the fourth semester. Also a draft of the review/research paper (submitted or prepared to be submitted) must be submitted to respective guide before seminar presentation.

M.Sc. (MOLECULAR BIOLOGY AND MOLECULAR DIAGNOSIS)

SEMESTER IV

05470402: Quality control & Laboratory safety

COURSE OBJECTIVES: The purpose of this course is to familiarize students about the concepts of quality control measures and measures of laboratory safety.

L	T	P	Credits		
-			4	Examination:	60 Marks
				Int. Assessment:	40 Marks

Total: 100 Marks

Unit I:

Introduction to laboratory quality management , Essential elements of Quality Assurance Programme , quality assurance, quality assessment, quality control,quality planning , Internal Quality control—Control of pre-analytical variables-- control of analytical variables, Quality Control of the chemicals, reagent, laboratory precision, accuracy & sensitivity ,basic steps – sources of error ,correction methods ,Corrective action preventive action , post analytical variables

Unit II:

Validation of methods--- Reference materials and calibrating definitive methods ---Systemic and random errors —Westgard rules -- Quality control charts--Levey-Jenning chart-- Cusum chart and Gaussian curve--- Internal and external factors for quality control assurance – external quality control, quality improvement, current trends in laboratory accreditation

Unit III Biosafety and Biosecurity - Introduction; historical background; introduction to biological safety levels, biosafety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals, biomedical hazard and disposal methods

Unit IV:

Basic principles of ethics in laboratory medicine , general application of ethical principle, Co-operation and working relationship with other health professionals, Respect and equal treatment , Dignity and privacy of patient, Communication and informed consent, Decision-making for incompetent patients, Responsibility from acquisition of the specimen to the production of data, confidentiality of information, storage and retention of medical records , access to medical records, Reporting unsafe or unethical practices, future of medical ethics