Colour Coding
Global GREEN
Regional BLUE
National ORANGE
Local (State) PINK

Curriculum
M.Sc. Molecular Medicine

Department of Molecular Medicine & Biotechnology
Sanjay Gandhi Postgraduate Institute of Medical Sciences,
PMSSY Building, Raebareli Road,
Lucknow 226014
(www.sgpgi.ac.in)

Preamble

The field of molecular medicine is often referred to as "future medicine". The field deals with understanding and identification of molecular basis of human diseases, and molecular approached for diagnosis and therapeutics. The objective of the program of M.Sc in Molecular Medicine & Biotechnology is to offer understanding about the molecular mechanisms that cause diseases, the available technologies in genomics, epigenetic and proteomics. This is an important aspect for personalized and improved translational medicine. The program will also provide practical skills that will help for developing newer prognostic, diagnostic and therapeutic tools. Thus the program will help in skill development that is has applications in both research and clinical laboratory work, and will contribute to the understanding about molecular basis of disease, processes, and molecular diagnostic & therapeutic tools.

In the First semester the students will be introduced to Molecular Medicine and learn fundamental research topics including, integrative physiology, cell & development biology, immune response in health & disease, instrumentation and analytical techniques. In Second Semester, knowledge of basic- as well as advance approaches in Molecular Medicine including 'omics'-techniques (including tehniques related to genomics, proteomics, metabolomics, pharmacogenomics), and recombinant DNA technology will be taught. In addition, the students will be acquainted with the fundamentals of research methodology including, hypothesis formulation, and the quantitative and qualitative strategies of research. Along with this they will develop understanding about scientific ethics, Intellectual Property Rights (IPR) and Patents. The Third semester on molecular basis of disease, preventive & regenerative medicine, will help them to understand disease origin, transmission and modern preventive approaches. The students will learn translational aspect of Molecular Medicine by advanced understanding of modern diagnostic and therapeutic approaches in disease diagnosis and prognosis with amalgamation of case study discussing potential therapeutic approaches used in molecular medicine. In fourth semester, student will develop deep understanding of Translational research in specific domain area. From the practical perspective, the student will be asked to independently handle research project within the department. This will help him/her to develop ethics and ethos of basic and translational research.

Objective

The aim of the M.Sc. Program is to provide the trainees with knowledge and skills in Molecular Medicine & Biotechnology relevant to research and services in a variety of settings in the field of Medicine in India. The program has been designed to offer in-depth knowledge in molecular and cellular mechanisms causing human diseases. The teaching is given at the frontiers of research in molecular medicine. After completing this program the students should be able to demonstrate an ability to independently analyze and evaluate data or research results generated from current methods and techniques as well as gain skills for the development of novel molecular diagnostics and therapies with applications in research, health care and industry or other functions of research and development activities, emphasizing current technologies in the field.

Specific Objectives

- To develop basic and applied scientific knowledge and skills in Molecular Medicine relevant to human health and disease.
- To get knowledge about the basic and advance research approaches including 'omics' approach such as Genomic, proteomic, metabolomics and pharmacogenomics and their applications.
- To develop awareness and to be acquainted with the concepts of bio-safety, bioethics, and good laboratory practices (GLPs)/ laboratory discipline (Quality Control (QC), validation, general lab practice and total quality management and accreditation) especially with regard to molecular biology.
- To develop research methodology skills including hypothesis formulation and proper interpretation of laboratory results to carry our translational research for understanding origins and mechanisms of human diseases, and to find novel ways of preventing, diagnosing and treating diseases.

COURSE INFORMATION

COURSE TITLE

Master of Science (M.Sc.) in Molecular Medicine & Biotechnology.

PROGRAMME COMPONENTS

The M.Sc. is a two-year (four semesters), full-time programme starting in the autumn semester.

The entire course is composed of total 90 credits including theory and practicals.

It shall have semester exam pattern with internal, mid and end term assessments.

CAREER PROSPECTS

The master's program in Molecular Medicine & Biotechnology will help to gain deep understanding of the subject and will prepare skilled manpower for wide range of career options including bio-medical research, healthcare, academics, scientific jobs in industries, scientific consultancy and entrepreneurship.

ACADEMIC REQUIREMENTS

Bachelor's degree (or 3-year equivalent) in any one of the following fields: Botany, Zoology, Chemistry, Microbiology, Biotechnology, Biochemistry, Biomedical science, Biology or any equivalent degree in Life Sciences from a recognized university securing minimum of 50% marks in aggregate.

Note-

- Candidates who have completed their Bachelor's degree through correspondence are not allowed.
- Bachelor's degree should be an English medium.

AGE LIMIT

The maximum age should be less than 30 years as prescribed in the advertisement for admission to the course. Any age relaxation will be based on State Government rules.

TOTAL NUMBER OF SEATS

Ten candidates will be admitted in each academic session including one sponsored candidate. If there is no qualified sponsored candidate available then the seat will be filled from open category candidate on merit basis.

MODE OF SELECTION

Selection of the candidates will be on the basis of merit obtained in the entrance examination of the Institute. The medium of instruction and examination will be in English.

FORMAT OF THE EXAMINATION

There will be one paper of 02 hours duration consisting of 100 multiple choice questions

Instructions

The general standard of entrance examination will be that of graduation in Basic science or an equivalent examination of an Indian University. No specific syllabus for entrance examination has been prescribed by the Institute.

In case of two or more candidates belonging to the same category obtaining equal marks in the entrance examination, their merit will be determined in order of preference as given bellow:

- Candidate older in age will be preferred
- Candidate obtaining higher marks in qualifying examination will be preferred (qualifying examination i.e. B.Sc. in Botany/ Zoology/ Chemistry/ Microbiology/ Biotechnology/ Biochemistry etc)

COURSE FEE

Semester fees for the course will be as per SGPGI norms and is subject to change as per decision of the Institute from time to time:

Particulars	Fees	Remark
Tuition Fees	Rs. 35,000/	Per semester
Caution Money	Rs. 10,000/-	Once at the time of admission. Refundable on completion of the course.
Examination fees	Rs.1000/-	Per semester
Supplementary examination fees	Rs. 500/-	Per examination
Re-evaluation fees	Rs. 400/-	Per subject
Hostel charges	Rs.6000/ (excluding mess charges)	Annual, if Institutional hostel accommodation is availed

STIPEND

No stipend will be paid to the student during the course. However students will be paid a stipend of Rs.8000/- per month (fixed) during the dissertation (subject to approval by competent authority).

HOSTEL FACILITY

Hostel facility is subject to availability and will be provided to the students at the rate of Rs. 6000/annum(excluding the mess charges), if available.

ACADEMIC YEAR

Academic sessions will be normally started from July every year along with other courses.

COURSE STRUCTURE

Colour Coding
Global GREEN
Regional BLUE
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Local (State) PINK

The course content for M.Sc. Molecular Medicine & Biotechnology has been framed as per UGC guidelines & DBT. To measure student's performance in each semester, Semester Grade Point Average (SGPA) system shall be adopted. Overall performance shall be measured as Cumulative Grade Point Average (CGPA) system (10 Point scale) at the end of the course. Course structure is as follows:

(L): Lecture, (T): Tutorial, (P): Practical.

For theory course 1 credit = 1 contact hour/week

For practical course 1 Credit = 2 hours of laboratory work/week)

Total Credits=90

SEMESTER-I

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-101	Introduction to Molecular Medicine	3 (L)+1(T)
2.	MMBT-102	Cell &Development Biology	3(L)+1(T)
3.	MMBT-103	Immune response in Health & Disease	3(L)+1(T)
4.	MMBT-104	Instrumentation &Analytical techniques	3(L)+1(T)
5.	MMBT-105	Laboratory Practicals	6(P)
6.	MMBT-106	Student Seminar	2(L)
		Total Credits in Semester I	**24**

SEMESTER-II

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-201	Omics approaches in Molecular Medicine	3 (L)+1(T)
2.	MMBT-202	Research Methodology & Computational Biology	3(L)+1(P)
3.	MMBT-203	Scientific Ethics, Biosafety & IPR	3(L)+1(T)
4.	MMBT-204	Recombinant DNA Technology	3(L)+1(T)
5.	MMBT-205	Laboratory Practicals	6(P)
6.	MMBT-206	Student Seminar	2(L)
		Total Credits in Semester II	**24**

SEMESTER-III

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-301	Molecular Basis of Disease	3(L)+1(T)
2.	MMBT-302	Regenerative Medicine	3(L)+1(T)
3.	MMBT-303	Molecular Diagnostics and Therapeutics	3(L)+1(T)
4.	MMBT-304	Case Reports in Molecular Medicine	2(P)
5	MMBT-305	Student Seminar : Advancement in Molecular Medicine	2(L)
		Total Credits in Semester III	**16**

SEMESTER-IV

1.	MMBT-401	Translational Research Approaches	3(L)+1(T)
2	MMBT-402	Dissertation	22(P)
		Total Credits in Semester-IV	**26**

Total Credits for all semesters : 24 +24 + 16 + 26 = 90

SYLLABUS

The curriculum and syllabi for the course shall be as prescribed and revised by the Academic Board of the Institute from time to time. However, to start with, a detailed and comprehensive syllabus in this regard is being annexed herewith (Annexure-1).

EQUIPMENTS FOR TRAINING

Students will be trained on various ultra-modern laboratory equipments established within and different departments of the Institute.

MODE OF TEACHING

Lecture, Tutorials, Group discussion; presentations, individual and group drills, group and individual field based assignments, workshops and seminar presentation.

TEACHING FACULTY

Departmental Faculty:

Dr. Swasti Tiwari (Course Coordinator, Professor & Head)

Prof. M. M. Godbole (Profesor)

Dr. Alok Kumar (Associate Professor)

Dr. Lokendra Kr. Sharma (Assistant professor)

Dr. Santosh Kr. Verma (Assistant professor)

Support faculty from following departments of SGPGIMS:

- Bio-statistics & Health informatics,
- Department of Pathology
- Guest faculty as and when required for specialized teaching

Adjunct faculty as and when required for specialized areas as per existing norms of the Institute

- Faculty members from following Department of KGMU: Biochemistry
- Faculty members from Dept of Biotechnology, Lucknow University
- Faculty members from Dept of Biotechnology, BBAU Central University Lucknow,
- Scientists from CDRI, IITR and CBMR

ELIGIBILITY TO APPEAR FOR M.Sc. MOLECULAR MEDICINE EXAMINATION

- A candidate shall not be permitted to register for the examination unless the HOD has certified that the candidate has satisfactorily completed the course modules leading to the examination by attending the required number of lectures, tutorials and assignments. An attendance of 80 % or more is required for all teaching activities.
- A candidate shall take the examination on the first occasion on which the examination is held after satisfactory completion of respective modules unless the candidate has submitted a medical certificate acceptable to the Board of Management of the SGPGI.

  Or
- The candidate has established to the satisfaction of the Specialty Board in Molecular Medicine and the Board of Management of the SGPGI that there is an adequate reason for being allowed to postpone appearing for the examination.
- A candidate who is unable to appear for any or all the papers of the examination on grounds of illness, or any other reason accepted by the HOD and who has not exhausted all the permitted attempts shall be required to appear for the examination at the next available opportunity.

FORMAT OF THE EXAMINATION

During the course, students will be continuously evaluated through internal assessments midterm and end-term examinations. A uniform pattern will be followed for each course as outlined below.

Theory Course:

	Format of assessment	**Marks**	**Total**
1	Internal assessments (2)	10 x 2	20
2	Mid-term Examination	25	25
3	Attendance & Overall Performance	5	5
4	End Term Examination	50	50
		Total Marks	100

Practical Course

	Format of assessment	Marks
1	Theory, Practicals & records	80
2	Viva Voce	20
	Total Marks	100

Project dissertation/thesis work

	Format of assessment	Marks
1	Thesis evaluation	40
2	Supervisor's evaluation	40
3	Presentation & Viva Voce	20
	Total Marks	100

MODE OF THE EXAMINATION

Internal assessments would be through quiz/extempore/assignments/MCQs. Midterm and end-term exams may have MCQs, short and long answer questions. Midterm exam shall be conducted two months prior to the semester examination so that it also serves as preparatory examination. Records and marks obtained in test will be maintained by the Department as per institute policy. The semester wise marks shall be as follows:

Table-1: Internal Assessment/Semester exam of 1st Semester (Total Marks= 600)

Paper	Subject Title	Maximum Marks
MMBT-101	Introduction to Molecular Medicine	100
MMBT-102	Cell & Development Biology	100
MMBT-103	Immune response in Health & Disease	100
MMBT-104	Instrumentation & Analytical techniques	100
MMBT-105	Laboratory Practicals	100
MMBT-106	Student Seminar	100
	Total Marks	**600**

Table-2: Internal Assessment/Semester exam of 2nd Semester (Total Marks= 600)

Paper	Subject Title	Internal Assessment
MMBT-201	Omics approach in Molecular Medicine	100
MMBT -202	Research Methodology & Computational Biology	100
MMBT -203	Scientific Ethics, Biosafety & IPR	100
MMBT -204	Recombinant DNA technology	100
MMBT -205	Laboratory Practicals	100
MMBT -206	Student Seminar	100
	Total Marks	**600**

Table-3: Internal Assessment/Semester exam of 3rd Semester (Total Marks 500)

Paper	Subject Title	Maximum Marks
MMBT-301	Molecular Basis of Disease	100
MMBT -302	Regenerative Medicine	100
MMBT -303	Molecular Diagnostics & Therapeutics	100
MMBT -304	Case Reports in Molecular Medicine	100
MMBT -305	Student Seminar: Advancement in Molecular Medicine	100
	Total Marks	**500**

Table-4: Internal Assessment/Semester exam of 4th Semester (Total Marks 200)

Paper	Subject Title	Maximum Mark
MMBT -401	Translational Research Approaches	100
MMBT -402	Dissertation	100
	Total Marks	**200**

GRADING SYSTEM

As per UGC guidelines & DBT course content, SGPA & CGPA system is adopted for each course which follows absolute grading system on 10-point scale. Letter grade system is used on examination marks summed up with appropriate weightage to compute a total out of 100 marks. The 10 point grading system with letter grade is as follows:

Letter Grade		Numerical Grade Points	Marks obtained (%)
O	**Outstanding**	**10**	**Above 90**
A+	**Excellent**	**9**	**Above 80 and ≤90**
A	**Very Good**	**8**	**Above 70 and ≤80**
B+	**Good**	**7**	**Above 60 and ≤70**
B	**Above Average**	**6**	**Above 50 and ≤60**
C	**Average**	**5**	**Above 45 and ≤50**
F	**Fail**	**0**	**<45**
Ab	**Absent**	**0**	**Absent**

SEMESTER GRADE POINT AVERAGE (SGPA) CALCULATION

The performance of a student in each semester is indicated as weighted average of the grade points as SGPA. It shall be calculated as follows:

SGPA = (Sum of each course Grade points x Credits earned in semester) / Total number of credits earned per semester)

CUMULATIVE GRADE POINT AVERAGE (CGPA) CALCULATION

Overall performance of the student from the time of his/her registration is obtained by calculating Cumulative Grade Point Average (CGPA), which is weighted average of the grade points obtained in all courses registered by the student since he/she entered the Department. It shall be calculated as follows

$$CGPA = \Sigma(C_i \times S_i) / \Sigma C_i$$

Where S_i is the SGPA of the ith semester and C_i is the total number of credits in that semester. Both SGPA and CGPA will be rounded up to two decimal points.

The CGPA obtained by student shall be classified into following division/class.

CGPA	Class/Division
Above 9	Outstanding
Above 8 to 9	First Class with distinction
6 to 8	First Class
5.5 to <6	High-Second Class
5 to <5.5	Second Class
4.5. to <5	Third Class

CGPA conversion to Percentage:

Adoption of absolute grading will implement following formula for conversion of CGPA to percentage. Percentage (%) = CGPA x 10

THE RESEARCH PROJECT LEADING TO DISSERTATION

- The candidate shall commence a research project under the guidance of one or more supervisors. The title of the research project, place where the research will be carried out and the supervisor/s should be approved by the Specialty Board in Molecular Medicine SGPGI prior to commencement of research. Research work has to be carried out in an academic/research/industrial institution where the necessary facilities are available.
- Continuous attendance, other than approved leave, is required when research is carried out and the candidates should ensure marking of their attendance regularly during the period assigned for research work.
- Allocation of research projects to candidates will be based on a ranking system.
- Before the commencement of the research work the candidates will be required to write a project proposal (Annex 2) under the guidance of the supervisor/s (Annex 3 and 4) and submit it to the Specialty Board through the supervisor/s. The research proposal will be reviewed (Annex 5) by a suitable reviewer. Thereafter, the candidates will be required to make an oral presentation on the research proposal.
- The duration of the research project would be approximately 4- 6 months.
- A progress report should be forwarded 3 months after commencement of the research project by the supervisor (Annex 6) to the Specialty Board in Molecular Medicine through the course co-ordinator. Progress review seminars will also be held regularly to monitor the progress of the research.

- At the end of the research project the candidate will be required to submit a dissertation (based on the research) before the expiry date which is decided by committee. (Annex 7).

FINAL SUBMISSION OF THE DISSERTATION

Three copies of the dissertation, permanently bound with revisions, if any, together with an electronic copy should be submitted to the HOD. The principal supervisor is required to certify that the candidate has attended to the corrections suggested at the viva voce examination. The final submission should be made within two weeks of the date of the viva voce examination.

EXAMINATION OF THE DISSERTATION

- Three copies of the dissertation (in temporary bound form) and an electronic copy should be submitted to the examination branch of the SGPGI. The dissertation should be in the form specified by the Specialty Board in Molecular Medicine and should be submitted on or before the assigned date for submission of dissertations.
- A copy of the dissertation shall be sent to two examiners appointed by the Specialty Board in Molecular Medicine and approved by the Senate. The supervisor/s may recommend appropriate examiners to the Specialty Board in Molecular Medicine. At least one of the examiners should be external to the place where the research was carried out.
- A candidate will pass the dissertation when both examiners assigned at least 45% Marks. The final mark for the dissertation will be the average of the marks assigned by the two examiners.
- A candidate will fail the dissertation when both examiners have assigned lower than 45% Marks. The final grade will be the average of the marks assigned by the two examiners.
- Where a dissertation has been assigned a pass grade by one examiner and a fail grade by the second examiner, a third examiner will be appointed to assess and award a mark for each such dissertation.
- The final mark to decide on pass/fail status of the candidates will be decided on the marks assigned by all three examiners. If two of the three examiners have assigned more than 45%, the candidate passes the dissertation and if two of the three examiners have assigned a grade less than 45%, then the candidate fails the dissertation. The final % assigned to the dissertation will be the average of marks assigned by the two examiners who show concurrence as described above.

- If the dissertation in its present form, though not of sufficient merit to pass, but is of sufficient merit to justify such action, the examiners may recommend that the candidate be permitted to present the dissertation in a revised form for evaluation within a period of three months of intimation by the SGPGI. The evaluation procedure for a revised dissertation will be the same as above.
- If a candidate has been failed by both examiners (as mentioned above) and the dissertation is of insufficient merit to be recommended for resubmission by the examiners, such candidates will not be awarded the M.Sc.

THE VIVA VOICE EXAMINATION

- Those candidates who pass the dissertation will be called for a viva voce examination.
- The viva voce examination will be conducted by the Board of Examiners. The Board will consist of the Chief Examiner appointed by the Director SGPGI (as the Chairperson) and the two dissertation examiners. The supervisors shall be present as observers.
- A candidate should obtain an average of at least 45% marks to pass the viva voce examination. The final grade will be the average of the marks assigned by the two examiners.
- A candidate will fail the viva voce examination if the assigned average grade is lower than 45%.
- If a candidate fails to satisfy the examiners at the viva voce examination, the Board of examiners may recommend that the candidate be permitted to present the same dissertation again and submit to a further viva voce examination within a period of three months intimated by the SGPGI.
- A candidate presenting for the viva voce examination at the second attempt will pass the viva voce examination if an average of at least 45% marks is obtained. A candidate will fail the viva voce examination if the assigned average grade is lower than 45%. In such instances the candidate will not be awarded the M.Sc. in Molecular Medicine.

ELIGIBILITY FOR AWARD OF THE DEGREE

A candidate is required to obtain at least 45% for the award of degree. The candidate with grade F in any of subject has to reappear in those subjects.

AND

The minimum grade should be C in each subject separately in

a) All subjects of three semesters

b) M.Sc. Dissertation

c) Viva voce examination

ATTENDANCE

- To appear in the annual examination a candidate must have minimum 80% attendance (irrespective of the kind of absence) of the total number of classes in theory and practical conducted in an academic year from the date of commencement of the session to the last working day as notified by the institute in each of the subjects prescribed for that year.
- Special classes conducted for any purpose shall not be considered for the calculation of percentage of attendance.
- A candidate lacking in prescribed percentage of attendance in any subjects either in theory or practical in the first appearance will not be eligible to appear for the Examination in that subject.

APPOINTMENT OF EXAMINERS

Convener: Course Coordinator, M.Sc. Molecular Medicine & Biotechnology, SGPGIMS, Lucknow.

Internal Examiners:

Faculty of Molecular Medicine & Biotechnology, SGPGIMS, Lucknow

External examiner (02):

Faculty of other Institutes/University nominated by the Dean, SGPGIMS, Lucknow on recommendation of the Chairman/Nodal Officer, College of Medical Technology, SGPGIMS, Lucknow.

COMPARTMENT EXAMINATION

- There would be a compartment examination to provide opportunity to failed candidates.
- Candidate who fails in only one subject will be placed in the compartment, provided he or she secures at least grade C in theory as well as in practical individually.
- Such candidate will be given only two chances to clear the compartment examination, which will be held after three to six weeks of declaration of the result.

- The candidate placed in compartment will be required to appear both in theory and practical.
- If a candidate fails to appear in the supplementary examination for any reason it will be considered that he/she has availed a chance.
- However, the candidate who is placed in the compartment in 1st semester then he/she will be allowed to attend the classes of 2nd semester.
- The candidate who is taking compartment examination of 1st along with 2nd semester examination, his/her result of semester examination will be declared only if he/she passes 1st semester examination
- In case he/she fails to clear the compartment examination in two subsequent attempts, he/she would deem to have failed and his/her name will be struck off from the rolls.

RESULT

The Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow will publish the result of examination as soon as possible after the examination has been held.

Based on the adoption of letter grades, grade points, SGPA and CGPA, institute will issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters. Transcipt issued will have information about the grading and credit system, interpretation of grades and conversion of CGPA to percentage.

VACATION (As per the institute norms)

Students will observe vacation as under:

Winter break	10 days in December
Summer break	10 days in June
Sick leave	10 days

ANNEXURE-1

M.Sc. Molecular Medicine & Biotechnology

Needs: Local : Pink, National : Orange, Regional: light blue, International : green

SYLLABUS

SEMESTER-I

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-101	Introduction to Molecular Medicine	3 (L)+1(T)
2.	MMBT-102	Cell &Development Biology	3(L)+1(T)
3.	MMBT-103	Immune response in Health & Disease	3(L)+1(T)
4.	MMBT-104	Instrumentation &Analytical techniques	3(L)+1(T)
5.	MMBT-105	Laboratory Practicals	6(P)
6.	MMBT-106	Student Seminar	2(L)
		Total Credits in Semester I	**24**

SEMESTER-II

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-201	Omics approaches in Molecular Medicine	3 (L)+1(T)
2.	MMBT-202	Research Methodology & Computational Biology	3(L)+1(P)
3.	MMBT-203	Scientific Ethics, Biosafety & IPR	3(L)+1(T)
4.	MMBT-204	Recombinant DNA Technology	3(L)+1(T)
5.	MMBT-205	Laboratory Practicals	6(P)
6.	MMBT-206	Student Seminar	2(L)
		Total Credits in Semester II	**24**

SEMESTER-III

SN	SUBJECT CODE	SUBJECTS	CREDITS
1.	MMBT-301	Molecular Basis of Disease	3(L)+1(T)
2.	MMBT-302	Regenerative Medicine	3(L)+1(T)
3.	MMBT-303	Molecular Diagnostics and Therapeutics	3(L)+1(T)
4.	MMBT-304	Case Reports in Molecular Medicine	2(P)
5	MMBT-305	Student Seminar: Advancement in Molecular Medicine	2(L)
		Total Credits in Semester III	**16**

SEMESTER-IV

1.	MMBT-401	Translational Research Approaches	3(L)+1(T)
2	MMBT-402	Dissertation	22(P)
		Total Credits in Semester-IV	**26**

Total Credits for all semesters : 24 +24 + 16 + 26 = 90

Semester I

MMBT-101: INTRODUCTION TO MOLECULAR MEDICINE

UNIT -I **Genome**: Structure and organization of human genome- nuclear and mitochondrial, replication and maintenance, SNPs and variations, Gene expression & regulation, Transcriptome, epigenetic modifications and the role of non-coding RNA, Proteomics and functional Genomics, integrative genomics

UNIT- II **Macromolecules and Metabolism**: Amino acids & their classification, Protein structure and types, Structure-function relationship in model proteins, Biochemistry of macromolecules: Nucleic acids, Lipids; Vitamins: and Carbohydrate. Chemical metabolism of biomolecules, Introduction to clinical biochemistry, Nutritional Biochemistry, malnutrition, malabsorption and interventional strategies, role of diet and nutrition in the prevention and treatment of metabolic disorders.

UNIT- III **Integrative Physiology I:** Introduction to Physiology & Molecular Interactions, Energy & Metabolism, Membrane Dynamics, Integration and Homeostasis, Introduction to the Endocrine System & Neurons and Neural Network, Central Nervous System, Autonomic/ Somatic Systems & Sensory Modalities, Muscles & Control of Body Movement,

UNIT - IV **Integrative Physiology II:** Cardiac Physiology & Hemodynamics, Blood & Mechanisms of Breathing, Gas Exchange & Renal Physiology, Fluid and Electrolyte Balance, Digestion & Metabolism/Energy Balance, Reproduction and Development

Suggested Reading:

- Molecular Medicine - An Introduction Author: Jens Kurreck, Cy Aaron Stein.
- Introduction to Molecular Medicine- Author Ross, D.W.
- Molecular Medicine: An Introduction. Jens Kurreck, Cy Aaron Stein.
- A primer of Genome Science: G. Gibson, V. M. Spencer
- Biochemistry Ed Lubert Stryer. W.H. Freeman and Company, New York.
- Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishers and distributors.
- Harper's Biochemistry. Ed. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell. Appleton and Lange, Stamford, Connecticut.
- Human Physiology, An Integrated Approach, 7 th edition ISBN-13: 978-0321981226 or Silverthorn DU, Human Physiology, An Integrated Approach, 6 th edition, ISBN-13: 978-0-321-81079-3.
- Best and Taylor's Physiological Basis of Medical Practice.
- Guyton-Hall-Textbook-Medical-Physiology.
- Ganong's Review of Medical Physiology, 24th Edition (LANGE Basic Science)
- Harper's Illustrated Biochemistry, 29e, Robert K. Murray, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil.

MMBT-102: CELL & DEVELOPMENT BIOLOGY

UNIT-I **Cellular Structure & Cell Biology Methods:** Cell: structural and functional organization, Cell motility, Sub cellular organelle like Nucleus, Endoplasmic reticulum, Golgi, Mitochondria, Lysosomes; Fractionation of sub cellular organelles, Principles and applications of the microscopy.

UNIT-II **Bio-membrane structure and Function:** Plasma Membrane: organization and properties, Dynamics transport across membrane, Cell signaling concepts :Types of receptors (Intracellular and cell surface), signal transduction by membrane bound, cytosolic and nuclear receptors via various pathways

UNIT-III **Endo-membrane System and Cellular Motility:** General organization of protein transport within and outside the cell, Mechanisms of endocytosis and exocytosis, Protein sorting and secretion, Vesicular transport, Mechanism of intracellular digestion

UNIT – IV **Cell Dynamics & Differentiation:** Cytoskeleton and cell surface, Microfilaments: Structural organization, cell motility and cell shape; Microtubule: Structural and functional organization, cilia, flagella, centriole; Intermediate filaments, Cell-cell interactions and cell matrix interaction, Cell differentiation, hormones and growth factors; Stem cell differentiation, Blood cell formation, Fibroblast and their differentiation

UNIT – V **Introduction to Development:** Defining development biology, morphogen gradient, stem cells, pluripotency, stem-cell plasticity, cellular signaling determination and differentiation, pattern formation, cell fate and cell lineages, developmental processes, developmental defects and disorders.

Suggested Reading:

- Molecular Biology of The Cell (Fifth edition), 2007 by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher: Garland Publications
- Molecular Cell Biology (sixth edition), 2008 by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira. Publisher: W H Freeman & Company
- Essential Cell Biology (Third Edition), 2009 by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher: Garland Science
- Gilbert SF., Barresi MJF. (2010) D*evelopmental Biology*; (9th Ed).; Sinauer Associates Inc
- Wolper L., Tickle C; (2001); *Principles of Development*; Oxford University Press, UK

MMBT-103: IMMUNE RESPONSE IN HEALTH & DISEASE

UNIT-I **Introduction**: Phylogeny of Immune system, innate and acquired immunity, Clonal nature of immune response. Organization and structure of lymphoid organs, Nature and Biology of antigens and super antigens. Antibody structure and function, antigen and antibody interactions, Major histocompatibility complex, HLA. Generation of antibody diversity and complement system.

UNIT-II **Cells of immune system:** Hematopoiesis and differentiation, lymphocyte trafficking, B-lymphocyte, T-lymphocytes, macrophages, Dendritic cells, natural killer and lymphokine activated killer cells. Eosinophils, neutrophils and mast cells. Activation of B and T- lymphocytes. Cell mediated cytotoxicity: mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity and macrophage mediated cytotoxicity.

UNIT-III **Antigen processing and presentation:** generation of humoral and cell mediated immune responses, cytokines and their role in immune regulation, T- cell regulation, MHC- regulation, Immunological tolerance, Hypersensitivity, Autoimmunity, Immunosenescence. Transplantation, Immunity to infectious agents (intracellular parasites, helminths & viruses), Tumor Immunology, AIDS and other immunodeficiencies, Hybridoma Technology and Monoclonal Antibodies.

UNIT-IV **Immunological Techniques**: Immonprecipitation, Chromatin Immunoprecipitation, ELISA, Western blotting, dot blot, ELISPOT, immunofluorescence, flow cytometry and Biosensor assays for assessing ligand–receptor interaction, lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays

Suggested Reading:

- Essentials of Immunology: Roitt. I. M
- Immunology (V or VI edition): Kuby J.
- Advanced Immunology (1991) Male D., Champion B. Cooke A. and Owen M.
- Principle and practice of Immunoassay (IInd ed.) Christopher P. Price and David J.
- Kuby Immunology Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne 6 Ed. 2007 Edition
- Delves P., Martin S., Burton D. and Roitt I (2011) Roitt's Essential Immunology (Essentials), 12th Edition.
- Murphy K. (2011) Janeway's Immunobiology, 8th Edition.
- Price C. P. and Newman D. J. (1997) Principles and Practice of Immunoassay, 2nd Sub Edition

MMBT-104: INSTRUMENTATION & ANALYTICAL TECHNIQUES

UNIT-I **Basic methods & techniques:** Preparation of chemical solution & buffers, pH measurement; cell disintegration; dialysis and ultra-filtration. Histology, tissue processing, sectioning, Stains and staining techniques.

UNIT-II **Microscopy and Centrifugation Techniques:** Principles and applications: simple, compound, phase-contrast and fluorescence microscopes, cell tracking and live cell Imaging, confocal, electron microscopy: SEM and TEM, principles and different types of Centrifugation techniques, applications in biomedical research.

UNIT-III **Spectrophotometric Techniques:** Electromagnetic spectrum, Beer Lambert's Law, UV/VIS, Fluorescent spectroscopy, Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy (AAS), ESR, NMR spectroscopy, Mass spectroscopy, Circular Dichroism, Flow Cytometry, ELISA

UNIT-IV **Chromatography and electrophoresis Techniques: Principle, t**ypes of chromatography, applications of chromatographic techniques in research and, diagnostics. Agarose, Polyacrylamide gel (native and SDS), Immunoelectrophoresis, Isoelectric focusing and 2-Dimension gel electrophoresis

UNIT V **Radio techniques:** Radioactivity & stable isotopes; radioactive decay; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters; Radioimmunoassay. Applications of isotopes; Radiotracer and distribution techniques, Clinical applications

Suggested Reading:

- White R (1990) Biochemical Techniques theory and practice. Waveland Press.
- Christion G. D. (2003) Analytical Chemistry (6th edition), Wiley.
- Wilson K. and Walker J. (2010) Principles & Techniques of Biochemistry & Molecular Biology (7th edition).Cambridge University Press, UK
- Plummer D. T. (2007) An Introduction to Practical Biochemistry (3rd edition).Tata McGraw-Hill Education.
- Skoog D. A., F, Holler J., Crouch S.R.(2007) Principles of Instrumental
- analysis (6th edition), Cengage Learning, USA.

MMBT-105: LABORATORY PRACTICALS (Tentative list)

1) Buffer preparation: Preparing various stock solutions such as phosphate buffer, acetate buffer and validate Henderson-Hasselbach equation.
2) Qualitative analysis of amino acids by Ninhydrin test
3) Estimation of protein by preparation of standard curve for quantitative estimation of proteins using BSA by Lowry's method.
4) Subcellular fractionation by differential centrifugation
5) Blood grouping
6) Introduction to anatomy, functioning & handling of upright and inverted epifluorescence microscope & confocal microscope.
7) Low speed separation of cells from animal blood or any mammalian cells from a culture.
8) To examine number and morphology of nucleus in given tissue sample by DAPI/PI staining
9) Analysis of Green Fluorescence Protein (GFP) tagged cells/tissue under fluorescence microscope. Quantifying intensity measurements after setting up thresholds, and improving contrast features.

MMBT-106: STUDENT SEMINAR

Presentation and discussion on topic relevant to semester I course content by student

Second Semester

MMBT-201: OMICS APPROACHES IN MOLECULAR MEDICINE

UNIT-I: **Genomics:** Structure and organization of prokaryotic and eukaryotic genomes, Databases, computational analysis of genes and regulatory regions, chromosomal mapping, Human Genome Project. Microarray: principle, techniques and applications, DNA/RNA sequencing: principle, tools and applications. Genome wide association studies (GWAS), Comparison of Microarray technology and High throughput sequencing technology.

UNIT II **Proteomics:** Overview of protein structures and functional relevance Protein identification and analysis methods: 2D analysis, peptide fingerprinting, Mass spectrometry, MLDI-ToF, Quantitative proteomics, clinical proteomics and disease biomarkers, mass spectral tissue imaging and profiling, Protein arrays-priciple, method and applications in diagnostics.

UNIT III **Metabolomics:** Introduction and overview of metabolites, processing methods, metabolic profiling methods, application of non tracer and tracer techniques in metabolomics (HPLC, NMR, LC-MS and GC-MS), Metabolic database and pathway analysis tools, applications of metabolomics, integration of metabolomics with transcriptomics/ functional proteomics.

UNIT IV **Pharmacogenomics-** Introduction, application in drug designing, therapeutic targets, Process in structural pharmacogenomics structural influence in the drug response, efficacy and metabolism of drugs. Tools for pharmacogenomic analysis. Pharmacokinetics (PK), Pharmacodynamics (PD), Clinical trials

Suggested Readings:

- Brown TA (2006) *Genomes*, 3rd Edition, Garland Science.
- Campbell AM and Heyer LJ (2007) *Discovering Genomics, Proteomics and*
- *Bioinformatics.* Benjamin Cummings.
- Primrose S and Twyman R (2006) *Principles of Gene Manipulation and Genomics,*
- 7th Edition, Blackwell.
- Rehm H (2006) *Protein Biochemistry and Proteomics*, 4th Edition, Academic Press.
- Twyman RM. (2013) *Principles of Proteomics*, Second Edition by Garland Science
- Taylor & Francis Group New York and London.
- Liebler DC (2002) *Introduction to Proteomics: Tools for the New Biology,*
- Humana Press, Totowa NJ. USA.
- Griffiths WJ, *Metabolomics, Metabonomics and Metabolite Profiling*, (The Royal
- Society of Chemistry UK) (2008) ISBN 978-0-85404-299-9
- Teresa Whei-Mei Fan (Editor), Andrew M. Lane (Editor), Richard M. Higashi
- (Editor) (2012) *The Handbook of Metabolomics*, Springer ISBN 978-1-61779-618-0.
- Dale Halsey Lea, Dennis J. Cheek, Daniel Brazeau, Gayle Brazeau (2015) Mastering Pharmacogenomics: A Nurse's Handbook for Success.
- Yui-Wing Francis Lam Larisa Cavallari, 2015 Challenges and Opportunities in Therapeutic Implementation. **ISBN:** 9780123983039

MMBT-202: RESEARCH METHODOLOGY & COMPUTATIONAL BIOLOGY

UNIT- I **Research Methodology:** Meaning, objective & types of research, Research Problem and designing research plan, Good Research practices, literature review, scientific writing & communications, types and basic principles of experimental design, Selection of appropriate methodology, research ethics.

UNIT- II **Data collection & Sampling:** Methods of data collection: Observation method, Interview method, Questionnaire method for the collection of primary data, Collection of secondary data, selection of appropriate method for data collection, Case study method. Guidelines for developing questionnaire

UNIT- III **Introduction to bioinformatics;** Database concepts, biological databases. Sequence alignment tools, Primer and Probe designing. Data mining, phylogenetic analysis, applications of bioinformatics in biomedical research

UNIT- IV **Biostatistics:** Introduction, concept of variables in biological systems. Data representation and summary measures for central tendency, dispersion, skewness and kurtosis of a frequency distribution. Classical, frequency and axiomatic approach of calculating probability, conditional probability and Bayes theorem. probability distribution: bionomial and normal distribution. Concepts of population and sample. framing hypothesis and possible errors. Testing hypothesis, ANOVA and regression analysis.

Recommended Readings:

- Bioinformatics. Bishop Martin
- Molecular databases for protein and sequence and structure studies: Sillince A. and Sillince M.
- Sequence Analysis primers: Gribskov, M. and Devereux, J.
- Bioinformatics: Sequence and Genome Analysis By David W. Mount, University of Arizona, Tucson
- Discovering Genomics, Proteomics, & Bioinformatics, Second Edition By A. Malcolm Campbell, Davidson College; Laurie J. Heyer, Davidson College; With a Foreword by Francis S. Collins

MMBT-203: SCIENTIFIC ETHICS, BIOSAFETY & IPR

UNIT- I **Scientific ethics**: General ethics and ethical issues, Animal rights, Biodiversity Necessity of bioethics, different paradigms of bioethics- national and international, Ethical issues against molecular technologies, Regulations of Genetically Modified Organisms (GMOs), Human Cloning, Bioethics for the future. Bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, biopiracy.

UNIT- II **Biosafety:** Definitions and biosafety levels, Biosafety for human and environment, General guidelines for rDNA research activity, Containment facilities and Biosafety practices, Guidelines for research in transgenics and applications, Structure and functions of biosafety committees, DBT guidelines on biosafety in conducting research in biology/biotechnology. biosafety research trials – standard operating procedures.

UNIT- III **Intellectual property right:** Basic Concepts of Intellectual Property, national & international Regulations, intellectual property laws, trade related aspects of IPR, IPR Laws, Patent, patent databases, analysis and report formation, copyright, trademark.

Suggested Readings:

- Ganguli, P. (2001). *Intellectual Property Rights: Unleashing the Knowledge Economy*. New Delhi: Tata McGraw-Hill Pub.
- National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
- Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.
- Kuhse, H. (2010). *Bioethics: an Anthology*. Malden, MA: Blackwell.
- Office of the Controller General of Patents, Design & Trademarks; Department of
- Industrial Policy & Promotion; Ministry of Commerce & Industry; Government
- of India. http://www.ipindia.nic.in/
- Karen F. Greif and Jon F. Merz, *Current Controversies in the Biological Sciences*
- *-Case Studies of Policy Challenges from New Technologies*, MIT Press
- World Trade Organisation. http://www.wto.org
- World Intellectual Property Organisation. http://www.wipo.int
- International Union for the Protection of New Varieties of Plants. http://www.upov.int
- National Portal of India. http://www.archive.india.gov.in
- National Biodiversity Authority. http://www.nbaindia.org
- Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from

MMBT-204: RECOMBINANT DNA TECHNOLOGY

UNIT - I **Introduction:** Basic principles of gene cloning and DNA Analysis, plasmid vectors, Phage infection cycle, DNA method and manipulation, restriction endonucleases, classification and their application, restriction mapping. DNA modifying enzymes: Nucleases, Polymerases, Phosphatases and DNA ligases, Kinases; ligation, adaptors, linkers/polylinkers and homo polymer tailing.

UNIT – II **Methods in gene manipulation:** Recombinant DNA Technology, competent cells, transformation, identification of recombinants, construction of Genomic and cDNA libraries, Selection, screening and analysis of recombinants, hybridization techniques: southern, northern & western blotting, polymerase chain reaction,

UNIT – III **DNA & RNA Techniques:** classical and advanced sequencing methods, human genome project, chromosome walking, contig assembly, sequence assembly, Genetic maps, Physical maps, RNA transcript, Transcript mapping, Transcript analysis and analysis., regulation of gene expression, Footprinting, Reporter genes, in vitro mutagenesis, in vitro mutagenesis techniques.

UNIT – IV **Application in health & disease:** genome annotation, use in clinical diagnostics of human diseases, forensics, genetic disorders, DNA profiling, Sex identification by DNA analysis, human archaeogenetics therapeutics Recombinant protein production, Recombinant vaccines, gene therapy,

Suggested Readings:

- Molecular Cloning: a Laboratory Manual, J Sambrook, E F Fritsch and T Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
- Genetic Engineering, An Introduction to gene analysis & exploitation in eukaryotes, SM Kingsman and A J Kingsman, Blackwell Scientific Publications, Oxford, 1998.
- Molecular Biotechnology (2nd Edn.) S B Primrose, Blackwell Scientific Publishers, Oxford, 1994
- Principles of Gene manipulation and Genomics (2006) S. B. Primrose and R. M. Twyman. 7th edition
- From Genes to Clones (2010) Winnaeker E.L. 4th edition
- Recombinant DNA (2007) Watson J.D., Witreowski J., Gilman M.
- and Zooller M. 2nd edition
- An Introduction to Genetic Engineering: Nicholl, D.S.T.3rd edition
- Molecular Biotechnology (2002) Pasternak. 4th edition
- The Biochemistry of Nucleic acid (2008) Adam et al. 11th edition
- Genetic Engineering (2006) Janke K. Swtlow

MMBT-205: LABORATORY PRACTICALS

- Separation of poteins by SDS-PAGE
- Isolation of genomic DNA
- Quantification and purity determination of isolated genomic DNA by UV-spectrophotometry and agarose gel electrophoresis.
- Preparation of competent cells
- Transformation of plasmid DNA into DH 5α strain of *E.coli*, calculation of transformation efficiency.
- Isolation of plasmid DNA by alkaline lysis and phenol method
- Separation of plasma and serum from blood
- Identification and estimation of the percentage of live and dead cells in the blood sample using Trypan Blue
- Lysis of RBC in the blood sample
- Estimation of the percentage of live and dead WBCs in the blood sample after RBC lysis using Trypan Blue.
- Counting of RBCs and WBCs using Haemocytometer
- Differential staining of cells in the blood sample using Wright-Giemsa staining method.
- Identification of structures in sections of brain stem and spinal cord at different levels. Staining nervous tissue using Crystal violet's staining and other special stains.
- To observe the phagocytosis process in macrophages.
- Using NCBI and Uniprot web resources.
- Introduction and use of various genome databases.
- Sequence information resource: Using NCBI, EMBL, Genbank, Entrez, Swissprot/ TrEMBL, UniProt.
- Similarity searches using tools like BLAST and interpretation of results
- Multiple sequence alignment using ClustalW
- Phylogenetic analysis of protein and nucleotide sequences.
- Use of various bioinformatics software

MMBT-206- STUDENT SEMINAR

Presentation and discussion on topic relevant to semester II course content by student

Third semester

MMBT-301: MOLECULAR BASIS OF DISEASE

UNIT I: **Fundamentals of Disease Biology:** Basic concept, Classification of diseases, mechanism, epidemiology, control and prevention of diseases, disease management.

Unit II: **Communicable disease:** Causes and symptoms, mode of transmission, host-pathogen interaction, etiology and pathogenesis of disease, signaling pathways, prevention and control, diagnostic and therapeutic approaches,

Unit III: **Non-communicable diseases:** Causes and symptoms, risk factors, etiology and disease progression, cell signaling, prevention and control measures, diagnostic and therapeutic approaches.

Unit IV: **Life style disorders:** Introduction, cause and symptoms, diagnosis, management, complications and prevention. Circadian rhythm, stress related disorders etc.

Suggested Reading:

- Molecular Basis of Health and Disease Das, Undurti N. 2011. Springer
- KC Carroll, SA Morse, T Mietzner, S Miller. (2016) Jawetz, Melnick and Adelbergs's Medical Microbiology 27th edition, McGraw Hill.
- V Kumar, AK. Abbas and JC Aster, (2015), Robbins & Cotran Pathologic Basis of Disease. 9th Edition, Elsevier.
- *Jens Kurreck; Cy Aaron Stein (16 February 2016).* Molecular Medicine: An Introduction. *John Wiley & Sons.* ISBN 978-3-527-33189-5.
- Massoud TF, Gambhir SS. Integrating noninvasive molecular imaging into molecular medicine: an evolving paradigm, Trends in Molecular Medicine, Vol. 13, No. 5, May 2007, pp. 183-191
- MS Runge, C Patterson, VA McKusick, Principles of Molecular Medicine, 2nd ed, p. 53, Humana Press, 2006 ISBN 1-58829-202-9.

MMBT-302: REGENERATIVE MEDICINE

UNIT – I: **Basics of Stem cells:** Types of stem cells, principles and techniques of stem cell culture, cellular signaling and maintenance of stemness, pluripotency, differentiation, organogenesis, reprogramming, transcription factors, trans-differentiation, cancer stem cells.

UNIT – II: **Tissue engineering and scaffold:** Historical overview and fundamentals of tissue engineering, tissue dynamics/ homeostasis, Biomaterials, scaffolds and growth factors in tissue engineering, application in human diseases.

UNIT III: **Cell culture technique:** Various systems of tissue culture, their distinguishing features, advantages and limitations. Culture medium: natural media, synthetic media, simple growth medium. Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence, hybridoma technology.

UNIT–IV: **Application of stem cell technologies:** Nuclear transfer, Transcription factors, trans-differentiation, animal models of regeneration, human stem cells and tissue engineering, embryonic stem cells, *Ex-vivo* and *in vivo* gene therapy, IVF Techniques, therapeutic cloning, clinical trials, ethical issues.

Suggested readings:

- Principles of Regenerative Medicine. Academic Press; 1 edition (December 4, 2007)
- Foundations of Regenerative Medicine: Clinical and Therapeutic Applications. Academic Press; 1 edition (August 28, 2009)
- Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press; 2013 edition (August 8, 2012)
- Regenerative Medicine.Springer; 1st Edition. edition (March 3, 2011)
- Regenerative Biology and Medicine, Second Edition.Academic Press; 2 edition (June 14, 2012)

MMBT-303: MOLECULAR DIAGNOSTICS & THERAPEUTICS

UNIT I: **DNA and RNA based Molecular Diagnosis:** Principles and techniques; Types of PCR, DNA & RNA hybridization techniques, in-situ (FISH), microarrays, Molecular detection of pathogens, Sequencing methods, Application in forensics, paternity identification, sex determination and detecting genetic disorders.

UNIT II: **Immunodiagnostics & Immunotherapy:** Antigen-antibody binding interactions and assays, antibodies, Immunoassays: types and specific applications, immuno-histochemistry, Application in human diseases.

UNIT III: **Molecular Therapeutics:** Identification of molecular targets of diseases, development of therapeutic molecules, Gene therapy application of nanotechnology, Pharmacogenomics.

UNIT-IV: **Clinical applications:** Advancements in therapeutic approaches, Gene therapy, Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; gene delivery methods, Cellular therapy; recombinant therapy, Immunotherapy, cytokine therapy, gene silencing technology, antisense therapy, use of molecular approaches in role in tissue & organ transplantation, personalized medicine, clinical trials.

Suggested reading:

- Campbell, A. M., & Heyer, L. J. (2006). *Discovering Genomics, Proteomics, and*
- *Bioinformatics*. San Francisco: Benjamin Cummings.
- Brooker, R. J. (2009). *Genetics: Analysis & Principles*. New York, NY: McGraw-Hill.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology:*
- *Principles and Applications of Recombinant DNA*. Washington, DC: ASM Press.
- Coleman, W. B., & Tsongalis, G. J. (1997). *Molecular Diagnostics: for the Clinical*
- *Laboratorian*. Totowa, NJ: Humana Press.
- Bernhard Palsson and Sangeeta N Bhatia, (2004), *Tissue Engineering,*
- 2nd Edition, Prentice Hall.
- Pamela Greenwell, Michelle McCulley, (2008), *Molecular Therapeutics:*
- *21st century Medicine*, 1st Edition, Springer.

MMBT-304: CASE PRESENTATION IN MOLECULAR MEDICINE

The case reports from literature that presents Genomic and Molecular analyses of individuals or cohorts alongside their clinical presentations and phenotypic information. The case reports in the core research areas of the teaching faculty will be included; Maternal health, Nephrology, Neurobiology, Oncology and Membrane fusion defects.

MBT-305: STUDENT SEMINAR -ADVANCEMENT IN MOLECULAR MEDICINE

Students will be encouraged to present seminar on recent advanced development in molecular medicine.

Fourth Semester

MMBT-401: TRANSLATIONAL RESEARCH APPROACHES

UNIT I **Translation research approach & challenges**: Model systems and Disease modeling- genetically-modified mouse models, organoid culture, biofluids and tissues from human; Population-based research, study design, clinical trials in integrative medicine; Personalized screening, diagnosis and therapeutics, extracellular vesicles, microfluidics and bioinformatics; Omics medicine- Bio-Banks, Databases, and a Comprehensive Knowledgebase; Printing Technologies; Drug re-purposing; Reverse translation; Approaches to overcome Practical Challenges- Consortium, multi-discipiniary team, regulatory agencies.

UNIT II **Molecular Membrane biology** Membrane bending in shaping, fusion & fission, Quality controls of membrane proteins, Lipid homeostasis and regulation, Lipid droplets in health and disease, Organelle biogenesis, identity, interactions, communications & disease, Membrane specialization in cells, Pathogen manipulation of host membrane, Technical advances in studying membrane biology

UNIT III **Molecular Neurobiology: Neuroanatomy-** Brain and its environment, Development of the nervous system, Neuron and Neuroglia, Somatic sensory system, Olfactory and optic pathways, Cochleovestibular and gustatory pathways, Motor pathways, Central autonomic pathways, Hypothalamo-hypophyseal system, Cross sectional anatomy of brain and spinal cord. **Pshychoneuroimmunology**-Basic principals in immunology, Innervation of the immune system, In vitro and In vivo assessment of immune system modulation of brain function and neurochemistry; Aging and the immune system, inflammatory roads to neurodegeneration: A focus on chronic neurodegerative disorders,

UNIT IV **Molecular Oncology:** Basics of cancer, cancer statistics, signaling mechanisms, current methodology in cancer research, animal models in cancer research, Warburg Hypothesis, Mitochondrial dysfunctions in cancer, metabolic alterations in cancer, oxidative stress, Apoptosis, Autophagy, Cancer Diagnosis and therapeutic approaches.

Suggested readings:

- Extracellular Vesicles in Health and Disease by Paul Harrison Hardcover Book by Paul Harrison Siegal, Basic Neurochemistry (7th Edition) Academic Press, 2006)
- Verkhartsky, Glial Neurobiology, A text Book , Wiley, 2007 Pshychoneuroimmunology Alexender W. Kusnecov and Hymie Anisman Wiley Blackwell, ISBN 978-1-119--97951-7, 2014.
- Molecular Biology of Human Cancers by Wolfgang Arthur Schulz Springer.(2007). 2nd edition
- Biology of Cancer by Robert Weinberg (2013). 2nd edition
- Chemoprevention of Cancer and DNA Damage by Dietary Factors by S. Knasmuller, David M. DeMarini, Ion Johnson, and Clarissa Gerhauser Willey- Blackwell Publisher. (2009). 1st edition

MMBT-402: DISSERTATION

Objectives

As partial requirement for the Award of M.Sc. Degree in Molecular Medicine & Biotechnology, a project culminating in the submission of a dissertation must be carried out by students in their final semester. The project-dissertation is a component that provides the students with the opportunity to design undertake or conduct an independent piece of research under the guidance of a supervisor. A 'Project' leads to a 'dissertation' that is assessed. The 'Dissertation' is a comprehensive description of the aims, objectives of the project, a review of the literature on the subject matter, the investigation/planning and methodology, the results and findings, and concrete recommendations and conclusions. Every student will submit a comprehensive report of the project work in the form of dissertation, duly certified by the supervisor appointed by the Head of the Department. The project will be presented by the student and evaluated by expert at the end of the semester. The students shall be required to present themselves for a comprehensive viva-voce examination before completion of the course.

- A 'Project' is an investigative undertaking, a structured, organized experiential learning including design work, field work or other placement learning.
- The dissertation is a major document that reflects the skills of the student to investigate critically a topic/problem, the ability to gather and analyze information, and to present and discuss the results/investigation concisely and clearly.
- Be a self-motivated and personally responsible for your action and learning
- Apply standard and advance techniques to solve a range of identified problems
- Be proficient in the recording, storage, management and reporting data