M.TECH- MOLECULAR MEDICINE

This M.Tech.program will provide training in the field of Molecular Medicine. The course is offered by the Division of Molecular Medicine, Amrita Centre for Nanosciences and Molecular Medicine, Amrita Institute of Medical Sciences and Research Centre, Amrita Vishwa Vidyapeetham. Molecular medicine is the study of molecular and cellular phenomena in biological systems that enhances our understanding of human diseases and facilitates discovery research in disease prevention, diagnosis and therapy using cutting edge technology. Molecular Biology offers new technology tools to probe the living organism, both in diagnostics and therapy. The integration of these two disciplines offers opportunities for many new fundamental insights into the mechanisms of disease and avenues for diagnostics and therapy that could not have been imagined even a decade earlier.

One of the unique strengths of this course is its emphasis on an interdisciplinary approach whereby medical sciences, molecular biology, bioinformatics and nanotechnology areas comes together. This is possible because this Centre offers other courses in Nanotechnology and Bio-Nanotechnology. Students will be encouraged to participate in interdisciplinary learning activities, and some of the courses from different programs are jointly offered. The curriculum is designed according to the national education policy guidelines incorporating flexibility with respect to the opportunity to exit after one year with a post graduate diploma following obtaining the required credits.

EDUCATIONAL OBJECTIVES.

- Developing individuals who is capable of harnessing diverse concepts and technology for developing new diagnostics and therapeutics with sound scientific background.
- Developing a thorough understanding of the basic concept of biology and medicine and its application in research and development.
- To establish careers in molecular medicine, medical biotechnology or in pharmaceutical industry diagnostics labs including setting up startups in biotechnology field.
- Developing critical thinking and professionalism to function effectively in diverse environment holding to scientific ethics and responsibility.

Curriculum
First Semester

Course Code	Type	New Course	LTP	Credits
24MM601	FC	Advanced Cell Biology	3 0 0	3
24MM602	FC	Molecular Biology	3 0 0	3
22AVP103	AC	Mastery Over Mind	1 0 2	2
24MM681	SC	Molecular Biology Lab	1 0 1	2
	HU	Amrita Values Program *	1 0 0	1
23HU601	HU	Career Competency-I	0 0 3	P/F
		ELECTIVES (Any Two)		6
		24MM631 Stem Cells and its Applications in Medicine. 300 3		
		24MM632 Bioinformatics and Structure based Drug Design 201 3		
		24MM633 Clinical Microbiology 300 3		
		24MM634 Organ Systems Physiology 300 3		
		Total Credits		**17**

Second Semester

Course Code	Type	New Course	LTP	Credits
24MM611	FC	Immunology	300	3
24MM612	FC	Clinical Biochemistry and Proteomics	300	3
24MM613	FC	Genetics: Principles and Analysis	300	3
24MM682	SC	Immunology and Microbiology Lab	101	2
24MM683	SC	Biochemistry Lab	101	2
		ELECTIVES (Any Two)		6
		24MM641 Drug Delivery, Pharmacokinetics & Pharmacodynamics 300 3		
		24MM642 Regenerative Medicine & Tissue Engineering 300 3		
		24MM643 Recombinant DNA Technology 300 3		
		24MM644 Molecular Basis of Diseases 300 3		
		24MM645 Cancer Biology 300 3		
				Total 19

Third Semester

Course Code	Type	New Course		Credits
24MM798	P	**Dissertation-I**		14
24MM701	AC	Statistical Data Analysis	101	2
24MM781	SC	Cell Culture and Animal Lab	101	2
24MM702	FC	Ethics in Research and Research Methodology	101	2
E		**ELECTIVES (Any One)**		2
		24MM731 Organoids And Organs-On-Chips — 200 — 2		
		24MM732 Molecular Diagnostics. — 200 — 2		
			Total Credits	**22**

Fourth Semester

Course Code	Type	New Course	LTP	Credits	
24MM799	P	**Dissertation-II**			**17**
23HU611	HU	Career Competency-II	00 3	1	**1**
				Total	**18**

Total Credits - 76

FIRST SEMESTER

24MM601 ADVANCED CELL BIOLOGY 3-0-0-3

Pre-requisites: Basic understanding of biology
Total number of classes: 45

Syllabus

Unit-1 Lectures 8

Cellular basis of life: Universal features of cells and how these features separate the living world from non-living world, Cells and laws of thermodynamics; Cell membrane: Membrane structure and how it supported origin of life, Role of membrane asymmetry in cellular functions, Membrane proteins and how they support cellular diversity, Transport of small molecules across the membranes and electrical properties of membranes, Types of membrane transport and examples of molecular mechanisms involved in transport;

Unit-2 Lectures 9

Internal organization of cells: Intracellular compartments and protein sorting: Compartmentalization of cells, Transport of proteins between intracellular compartments, Molecular mechanisms underlying protein sorting and transport across intracellular compartments, Glycosylation and its significance; Intracellular membrane traffic: Intracellular vesicular transport and underlying molecular mechanisms, Maintenance of compartmental diversity, Molecular mechanisms underlying specificity of molecular transport, Molecular mechanisms underlying transport into the cell from the plasma membrane and transport from trans-golgi network to cell exterior;

Unit-3 Lectures 8

Communication between cells and the exterior: Cell signaling: General principles governing cell signaling, Types of cell communication, Negative feedback, Positive feedback, Signaling through GPCRs and enzyme-coupled surface receptors; Cytoskeleton: Types of cytoskeletal filaments, Molecular mechanisms involved in self-assembly and dynamic structure of cytoskeletal filaments, Polymerization and depolymerization of cytoskeletal filaments coupled to cellular functions, Molecular motors and their significance in intracellular transport, Cytoskeleton in cell division;

Unit-4 Lectures 8

Cellular reproduction, the basis of sustenance of life on earth: Cell cycle: Role of templated polymerization of DNA in cellular reproduction and sustenance of life, Cell cycle control system in each phase of cell cycle, Regulation of cell cycle control system in different phases of cell cycle, Molecular mechanisms underlying cell cycle regulation, Control of cell growth; Apoptosis: Different types of cell death, Molecular pathways underlying cell death, Biological significance of cell death; Cancer from a cell's perspective: Cancer as a microevolutionary process resulting from failure of cellular surveillance system;

Unit-5 Lectures 4

Cells in their social context: Contacts between cell to cell and cells to extracellular matrix: Cell adhesions, Extracellular matrix, Types of junctions between cells and cells and matrix, Role of junctions in tissue formation and functions of organs;

Unit-6 Lectures 4

How cells ensure continuity of life as well as genetic diversity on earth: Germ cells and sexual reproduction: Germ cells as the cells equipped to transfer genetic information between generations, Sexual reproduction as a cellular process ensuring genetic diversity at the organismal levels;

Unite-7 **Lectures 4**

Cells during development: Developmental dynamics of cells: How cells undergo commitment, specification and lineage diversification during development, Contribution of cells in pattern formation, Developmental biology of cells from the perspective of diseases and tissue maintenance;

TEXT BOOK:

Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P, "Molecular Biology of the Cell", Fifth and Sixth Editions, Garland Publishing Inc. 2008.

REFERENCE:

Gerald Karp, "Cell and Molecular Biology", Fifth Edition, John Wiley, 2008.

Course Outcome

CO1 To comprehend cell as the basic unit of life by studying the universal features of cells that distinguish the living and nonliving
CO2 To understand the internal organization of cells, molecular bases of membrane transport, intracellular membrane traffic, cell communication and cytoskeleton
CO3 To understand cell cycle and cell death as the bases for sustenance of life and cancer as a microevolutionary process originating from failure of cellular surveillance
CO4 To perceive about a cell in its social context by studying cell – cell adhesions and cell – matrix associations
CO5 To appreciate contribution of cells in reproduction and maintenance of genetic diversity, and the dynamic changes cells undergo during development

Program Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

0 – No affinity; 1 – low affinity; 2 – Medium affinity; 3 – High affinity

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	2	1	2	3	0	0	0	0	3
CO 2	3	2	2	2	2	2	1	0	0	0	0	3
CO 3	3	2	2	2	2	2	1	0	0	0	0	3
CO 4	3	2	2	2	2	2	1	0	0	0	0	3
CO 5	3	2	2	2	2	2	3	0	0	0	0	3

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	1	1	1	1	0	0	2	0	0
CO 2	3	2	3	2	3	0	1	3	1	0
CO 3	3	3	3	3	3	0	1	2	0	0
CO 4	3	2	3	2	3	0	1	2	0	0
CO 5	3	3	2	2	2	0	0	3	0	0

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM602 MOLECULAR BIOLOGY 3-0-0-3

Pre-requisites: Undergraduate level basic DNA biology
Total number of classes: 45

Preamble

This course will provide a thorough understanding about biology of DNA and how its regulations are brought about, its functional significance and how it is very much involved in the biochemistry and physiology of the cell.

Syllabus

Unit 1 (Lectures 10)

DNA: Structure and function, Chromosome and chromatin, Genetic code, wobble hypothesis, RNA and types of RNA (rasiRNA, tasiRNA, nat-siRNA, piRNA), Proteins and their structure

Unit 2 (Lectures 10)

DNA replication and its regulation, Homologous and site-specific recombination, DNA repair

Unit 3 (Lectures 10)

Transcription and its regulation, Translation and its regulation, Gene structure, Repeats and clusters, Gene expression regulations: operon, Epigenetics

Unit 4 (Lectures 5)

Types of mutations, Genetic system of mitochondria

Unit 5 (Lectures 10)

Gene identification, promoter identification, Molecular biology techniques: Isolation and Quantification of DNA/RNA, PCR, Reverse transcriptase PCR, Real Time PCR, DNA Sequence analysis, hybridization (southern, northern and western) and Sanger sequencing.

TEXT BOOK:

Lewin's Essential Genes, Jocelyn E. Krebs, Benjamin Lewin, Elliott S. Goldstein, Stephen T. Kilpatrick,Jones& Bartlett Publishers, 2013 - Science - 847 pages

REFERENCES

Molecular Biology of the Gene, Seventh Edition, James D. Watson, Cold Spring Harbor Laboratory; Tania A. Baker, Massachusetts Institute of Technology; Alexander Gann, Cold Spring Harbor Laboratory; Michael Levine, University of California, Berkeley; Richard Losick, Harvard University,2013

Course Outcome

CO1 Understand the structure and function of DNA, RNA and proteins
CO2 Understand the basics of DNA and RNA replication, transcription, translation and DNA-repair systems
CO3 Understand how genetic switches work, the basics of gene regulation in prokaryotes and eukaryotes
CO4 Understand the consequences of different types of mutations and recombinations
CO5 Understand basic and advanced molecular biology concepts and techniques
PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society

PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	1	-	-	-	-	-	-	1
CO 3	3	2	1	2	2	1	-	-	-	-	-	1
CO 4	3	3	1	2	2	-	-	-	-	-	-	2
CO 5	3	1	2	1	3	2	-	-	-	-	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	2	1	-	1	-	-	-	-	1
CO 2	3	2	1	-	1	_	-	-	-	1
CO 3	3	2	3	-	1	1	-	-	-	-
CO 4	3	3	3	1	1	-	-	-	-	2
CO 5	-	2	-	3	2	2	-	-	-	3

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%

Total	**100%**

Mastery Over Mind

22AVP103 Mastery Over Mind (MAOM) 1-0-2 2

1. Course Overview

Master Over the Mind (MAOM) is an Amrita initiative to implement schemes and organise university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3). This program as part of our efforts for sustainable stress reduction gives an introduction to immediate and long-term benefits and equips every attendee to manage stressful emotions and anxiety facilitating inner peace and harmony.

With a meditation technique offered by Amrita Chancellor and world-renowned humanitarian and spiritual leader, Sri Mata Amritanandamayi Devi (Amma), this course has been planned to be offered to all students of all campuses of AMRITA, starting off with all first years, wherein one hour per week is completely dedicated for guided practical meditation session and one hour on the theory aspects of MAOM. The theory section comprises lecture hours within a structured syllabus and will include invited guest lecture series from eminent personalities from diverse fields of excellence. This course will enhance the understanding of experiential learning based on university's mission: "Education for Life along with Education for Living", and is aimed to allow learners to realize and rediscover the infinite potential of one's true Being and the fulfilment of life's goals.

2. Course Syllabus

Unit 1 (4 hours)

Causes of Stress: The problem of not being relaxed. Need for meditation -basics of stress management at home and workplace. Traditions and Culture. Principles of meditation– promote a sense of control and autonomy in the Universal Human Value System. Different stages of Meditation. Various Meditation Models. Various practices of Meditation techniques in different schools of philosophy and Indian Knowledge System.

Unit 2 (4 hours)

Improving work and study performance. Meditation in daily life. Cultivating compassion and good mental health with an attitude of openness and acceptance. Research and Science of Meditation: Significance of practising meditation and perspectives from diverse fields like science, medicine, technology. philosophy, culture, arts, management, sports, economics, healthcare, environment etc. The role of meditation for stress and anxiety reduction in one's life with insights based on recent cutting-edge technology. The effect of practicing meditation for the wholesome wellbeing of an individual.

Unit 3 (4 hours)

Communications: principles of conscious communication. Relationships and empathy: meditative approach in managing and maintaining better relationships in life during the interactions in the world, role of MAOM in developing compassion, empathy and responsibility, instilling interest, and orientation to humanitarian projects as a key to harness intelligence and compassion in youth. Methodologies to evaluate effective awareness and relaxation gained from meditation. Evaluating the global transformation through meditation by instilling human values which leads to service learning and compassion driven research.

TEXT BOOKS:

1.Mata Amritanandamayi Devi, “Cultivating Strength and vitality,” published by Mata Amritanandamayi Math, Dec 2019

2.Swami Amritaswarupananda Puri ,”The Color of Rainbow “ published by MAM, Amritapuri.

REFERENCES:

1.Craig Groeschel, “Winning the War in Your Mind: Change Your Thinking, Change Your Life” Zondervan Publishers, February 2019

2.R Nagarathna et al, “New Perspectives in Stress Management “Swami Vivekananda Yoga Prakashana publications, Jan 1986

3. Swami Amritaswarupananda Puri “Awaken Children Vol 1, 5 and 7 - Dialogues with Amma on Meditation”, August 2019
4. Swami Amritaswarupananda Puri “From Amma’s Heart - Amma’s answer to questions raised during world tours” March 2018
5. Secret of Inner Peace- Swami Ramakrishnananda Puri, Amrita Books, Jan 2018.
6. Mata Amritanandamayi Devi “Compassion :The only way to Peace:Paris Speech”, MA Center, April 2016.
7. Mata Amritanandamayi Devi “Understanding and collaboration between Religions”, MA Center, April 2016.
8. Mata Amritanandamayi Devi “Awakening of Universal Motherhood: Geneva Speech” M A center, April 2016.

3. Evaluation and Grading

Internal			**External**	**Total**
Components	*Weightage*		Practical (attendance and class participation) 60%	100%
Quizzes(based on the reading material)	20%	40%		
Assignments (Based on webinars and lecture series)	20%			

4. Course Outcomes (CO)

CO1: Relate to the causes of stress in one’s life.
CO2: Experiment with a range of relaxation techniques CO3: Model a meditative approach to work, study, and life.
CO4: Develop appropriate practice of MA-OM technique that is effective in one’s life CO5: Inculcate a higher level of awareness and focus.
CO6: Evaluate the impact of a meditation technique

***Programme Outcomes(PO)**(As given by NBA and ABET)
PO1: Engineering Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Engineer and Society
PO7: Environment and Sustainability
PO8: Ethics

PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

CO – PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO 1	3	3	3	2		-	2	3	-	3	-	3	-	-	-
CO 2	3	3	3	2	2	_	2	3	3	3	-	3	-	-	-
CO 3	3	3	2	2	2	2	2	3	3	3	-	3	-	-	-
CO 4	3	3	3	2	-	2	3	3	3	3	-	3	-	-	-
CO 5	3	2	2	2	-	2	-	3	2	2	-	2	-	-	-
CO 6	3	2	2	2	3	2	_	3	2	2	-	2	-	-	-

24MM681 MOLECULAR BIOLOGY LAB 1-0-1-2

Pre-requisites: Basic understanding of DNA chemistry and DNA biology
Total number of classes: 30

Syllabus

Isolation of chromosomal DNA from Escherichia coli;Agarose gel electrophoresis, Isolation of chromosomal DNA from human blood; Isolation of plasmid DNA from Escherichia coli; Nucleic acid quantification; Polymerase chain reaction (PCR), Restriction digestion, Restriction fragment length polymorphism (RFLP), RNA isolation from Escherichia coli;
cDNA synthesis, Reverse Transcriptase PCR, DNA sequencing, Real time PCR.

Course Outcome

CO1 Explain the principles of the DNA & RNA isolation methods, PCR, agarose gel electrophoresis, sequencing methods.
CO2 Can isolate DNA, RNA, plasmids.
CO3 Can perform PCR, cDNA synthesis, RT-PCR, Real-time PCR, and sequencing.
CO4 Can follow general safety routines for laboratory work in molecular biology.
CO5 Can plan experimental work based on a protocol.
CO6 Can critically evaluate and discuss experimental results.

TEXT BOOK

1. Joseph Sambrook, David William Russell, Molecular Cloning: A Laboratory Manual, Volume 1-2-3 CSHL Press, 2001.
2. Terence A. Brown, Essential Molecular Biology: A Practical Approach, Volume 1 Oxford University Press, 2000.
3. Udo Reischl; Molecular Diagnostics of infectious diseases; Humana Press.
4. Adrian J Harwood, Methods in Molecular Biology; Protocols for gene analysis.
5. Frederick M Ausubel, Roger Brent, Robert D Moore, J G Seidman, John A smith, Kevin Struhl; Current protocols in Molecular Biology, John Wiley and Sons, Inc (Volume 1-4).

REFERENCE

Gene Therapy Technologies, Applications and Regulations: From Laboratory to Clini. Anthony Meager 1999 John Wiley & Sons, Ltd.

Course Outcome

CO1 Explain the principles of the DNA & RNA isolation methods, PCR, agarose gel electrophoresis, sequencing methods.
CO2 Can isolate DNA, RNA, plasmids.
CO3 Can perform PCR, cDNA synthesis, RT-PCR, Real-time PCR, and sequencing.
CO4 Can follow general safety routines for laboratory work in molecular biology.
CO5 Can plan experimental work based on a protocol and critically evaluate and discuss experimental results.

Programme Outcomes(PO)(As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

Program Specific Outcomes. (PSO)

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	1	3	1	-	1	3	-	-	1
CO 2	3	2	3	3	3	1	-	1	3	-	-	1
CO 3	3	2	3	3	3	1	-	1	3	-	-	1
CO 4	2	3	3	2	2	1	-	-	-	-	-	1
CO 5	3	3	1	2	3	2	-	-	-	-	-	1

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	2	-	1	3	1	2	-	-	-	1
CO 2	-	-	-	3	1	1	-	-	-	1
CO 3	-	-	-	3	1	1	-	-	-	1
CO 4	-	-	-	3	-	-	-	-	-	-
CO 5	-	-	-	3	-	-	-	-	-	-

Evaluation Pattern: 30+70 = 100

Internal Assessment – 30%		
Records	Evaluation	30%
		30%
End Semester Examination- 50%		
Practical	Exam	60%
Assessment	Viva	10%
		70%
	Total	**100%**

Amrita Values Program 1 0 0 1

Amrita University's Amrita Values Program (AVP) is a new initiative to give exposure to students to the richness and beauty of the Indian way of life. India is a country where history, culture, art, aesthetics, cuisine, and nature exhibit more diversity than anywhere else in the world. Amrita Values Programs emphasize making students familiar with the rich tapestry of Indian life, culture, arts, science, and heritage which has historically drawn people from all over the world. Post-graduate students shall have to register for any one of the following courses, in the second semester, which may be offered by the respective school.

Courses offered under the framework of the Amrita Values Program:

22AVP501 Message of Śrī Mātā Amritanandamayi Devi

Amma's messages can be put into action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks, and the guidance received in matters which we consider trivial are rich in content and touches the veryinner being of our personality. Life gets enriched by Amma's guidance, and She teaches us theart of exemplary life skills where we become witness to all the happenings around us keepingthe balance of the mind.

22AVP502 Insights from the Ramayana

The historical significance of Ramayana, the first Epic in the world, influence of Ramayana on Indian values and culture, storyline of Ramayana, study of leading characters in Ramayana, influence of Ramayana outside India, misinterpretation of Ramayana by colonial powers and its impact on Indian life, relevance of Ramayana for modern times.

22AVP503 Insights from the Mahabharata

The historical significance of Mahabharata, the largest Epic in the world, influence of Mahabharata on Indian values and culture, storyline of Mahabharata, study of leading characters in Mahabharata, Kurukshetra War and its significance, importance of Dharma in society, message of the Bhagavad Gita, relevance of Mahabharata for modern times.

22AVP504 Insights from the Upanishads

Introduction: Sruti versus Smrti, overview of the four Vedas and the ten Principal Upanishads,the central problems of the Upanishads, ultimate reality, the nature of Atman, the different modes of consciousness, Sanatana Dharma and its uniqueness, The Upanishads and Indian Culture, relevance of Upanishads for modern times, a few Upanishad Personalities: Nachiketas,Satyakama Jabala, Aruni, Shvetaketu.

22AVP505 Insights from Bhagavad Gita

Introduction to Bhagavad Gita, brief storyline of Mahabharata, context of Kurukshetra War, the anguish of Arjuna, counsel by Sri. Krishna, key teachings of the Bhagavad Gita, Karma Yoga, Jnana Yoga, and Bhakti Yoga, theory of Karma and Reincarnation, concept of Dharma,idea of the self and realization of the self, qualities of a realized person, concept of Avatar, relevance of Mahabharata for modern times.

22AVP506 Message of Swami Vivekananda

Brief sketch of Swami Vivekananda's life, meeting with Guru, disciplining of Narendra, travel across India, inspiring life incidents, address at the parliament of religions, travel in the United States and Europe, return and reception India, message to Indians about our duties to the nation.

22AVP507 Great Spiritual Teachers of India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramanujacharya, Sri Madhvacharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi

22AVP508 Indian Arts and Literature:

The aim of this course is to present the rich literature, culture of ancient India, and help studentsappreciate their deep influence on Indian life, Vedic culture, the primary source of Indian culture, brief introduction, and appreciation of a few of the art forms of India, arts, music, dance, theatre, paintings, sculpture and architecture, the wonder language, Sanskrit, and ancientIndian Literature.

22AVP509 Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and AshtangaYoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP510 Appreciation of Kerala's Mural Art Forms:

A mural is any piece of artwork painted or applied directly on a wall, ceiling, or another largepermanent surface. In the contemporary scenario, Mural painting is not restricted to permanentstructures and is being done even on canvas. A distinguishing characteristic of mural paintingis that the architectural elements of the given space are harmoniously incorporated into the picture. Kerala mural paintings are frescos depicting mythology and legends, which are drawnon the walls of temples and churches in South India, principally

in Kerala. Ancient temples, churches, and places in Kerala, South India, display an abounding tradition of mural paintingsmostly dating back to the 9th to 12th centuries CE when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objectiveof this course.

22AVP512 Ancient Indian Science and Technology

Science and technology in ancient and medieval India covered all the major branches of humanknowledge and activities, including mathematics, astronomy, physics, chemistry, medical science and surgery, fine arts, mechanical, civil engineering, architecture, shipbuilding, and navigation. Ancient India was a land of sages, saints, and seers as well as a land of scholars and scientists. The course gives awareness of India's contribution to science and technology.

CIR Course - MTech

23HU601	**Career Competency I**	**L-T-P-C: 0-0-3-P/F**

Pre-requisite: An open mind and the urge for self-development, basic English language skills and knowledge of high school level arithmetic.

Course Objectives:

- Help students transit from campus to corporate and enhance their soft skills
- Enable students to understand the importance of goal setting and time management skills
- Support them in developing their problem solving and reasoning skills
- Inspire students to enhance their diction, grammar and verbal reasoning skills

Course Outcomes:

CO1: Soft Skills - To develop positive mindset, communicate professionally, manage time effectively and set personal goals and achieve them.
CO2: Soft Skills - To make formal and informal presentations with self-confidence.
CO3: Aptitude - To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.
CO4: Aptitude - To analyze, understand and apply suitable techniques to solve questions on logical reasoning and data analysis.
C05: Verbal - To infer the meaning of words and use them in the right context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.
C06: Verbal - To identify the relationship between words using reasoning skills. To understand and analyze arguments and use inductive/deductive reasoning to arrive at conclusions and communicate ideas/perspectives convincingly.

CO-PO Mapping

PO / CO	**PO1**	**PO2**	**PO3**
CO1	2	1	-
CO2	2	1	-
CO3	2	1	-

CO4	2	1	-
CO5	1	2	-
CO6	2	2	-

Syllabus

Soft Skills

Introduction to 'campus to corporate transition':

Communication and listening skills: communication process, barriers to communication, verbal and non-verbal communications, elements of effective communication, listening skills, empathetic listening, role of perception in communication.

Assertiveness skills: the concept, assertiveness and self-esteem, advantages of being assertive, assertiveness and organizational effectiveness.

Self-perception and self-confidence: locus of control (internal v/s external), person perception, social perception, attribution theories-self presentation and impression management, the concept of self and self-confidence, how to develop self-confidence.

Goal setting: the concept, personal values and personal goals, goal setting theory, six areas of goal setting, process of goal setting: SMART goals, how to set personal goals

Time management: the value of time, setting goals/ planning and prioritizing, check the time killing habits, procrastination, tools for time management, rules for time management, strategies for effective time management

Presentation skills: the process of presentation, adult learning principles, preparation and planning, practice, delivery, effective use of voice and body language, effective use of audio visual aids, dos and don'ts of effective presentation

Public speaking-an art, language fluency, the domain expertise (Business GK, Current affairs), self-confidence, the audience, learning principles, body language, energy level and conviction, student presentations in teams of five with debriefing

Verbal

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misspelt words, commonly confused words and wrong form of words in English.

Grammar: Train students to understand the nuances of English Grammar and thereby enable them to spot grammatical errors and punctuation errors in sentences.

Reasoning: Stress the importance of understanding the relationship between words through analogy questions and learn logical reasoning through syllogism questions. Emphasize the importance of avoiding the gap (assumption) in arguments/ statements/ communication.

Oral Communication Skills: Aid students in using the gift of the gab to improve their debating skills.

Writing Skills: Introduce formal written communication and keep the students informed about the etiquettes of email writing. Make students practise writing emails especially composing job application emails.

Aptitude

Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.

Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest.

Ratio, Proportion & Variation: Basics, Alligations, Mixtures, and Partnership.

Averages: Basics, and Weighted Average.

Time and Work: Basics, Pipes & Cistern, and Work Equivalence.

Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.
Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.
Data Interpretation: Tables, Bar Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, and other forms of data representation.
Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.
Logarithms, Inequalities and Modulus: Basics

References

Soft Skills

Communication and listening skills:

- Andrew J DuRbin , "Applied Psychology: Individual and organizational effectiveness", Pearson- Merril Prentice Hall, 2004
- Michael G Aamodt, "An Applied Approach, 6th edition", Wadsworth Cengage Learning, 2010

Assertiveness skills:

- Robert Bolton, Dorothy Grover Bolton, "People Style at Work..and Beyond: Making Bad Relationships Good and Good", Ridge Associates Inc., 2009
- John Hayes "Interpersonal skills at work", Routledge, 2003
- Nord, W. R., Brief, A. P., Atieh, J. M., & Doherty, E. M., "Meanings of occupational work: A collection of essays (pp. 21- 64)", Lexington, MA: Lexington Books, 1990

Self-perception and self-confidence:

- Mark J Martinko, "Attribution theory: an organizational perspective", St. Lucie, 1995
- Miles Hewstone, "Attribution Theory: Social and Functional Extensions", Blackwell, 1983

Time management:

- Stephen Covey, "The habits of highly effective people", Free press Revised edition, 2004
- Kenneth H Blanchard , "The 25 Best Time Management Tools & Techniques: How to Get More Done Without Driving Yourself Crazy" , Peak Performance Press, 1st edition 2005
- Kenneth H. Blanchard and Spencer Johnson, "The One Minute Manager" , William Morrow, 1984

Verbal

- Erica Meltzer, "The Ultimate Guide to SAT Grammar"
- Green, Sharon, and Ira K. Wolf, "Barron's New GRE", Barron's Educational Series, 2011
- Jeff Kolby, Scott Thornburg & Kathleen Pierce, "Nova's GRE Prep Course"
- Kaplan, "Kaplan New GRE Premier", 2011-2012
- Kaplan's GRE Comprehensive Programme
- Lewis Norman, "Word Power Made Easy", Goyal Publishers, Reprint edition, 1 June 2011
- Manhattan Prep, "GRE Verbal Strategies Effective Strategies Practice from 99th Percentile Instructors"
- Pearson- "A Complete Manual for CAT", 2013
- R.S. Aggarwal, "A Modern Approach to Verbal Reasoning"
- S. Upendran, "Know Your English", Universities Press (India) Limited, 2015
- Sharon Weiner Green, Ira K. Wolf, "Barron's New GRE, 19th edition (Barron's GRE)", 2019
- Wren & Martin, "English Grammar & Composition"
- www.bbc.co.uk/learningenglish
- www.cambridgeenglish.org
- www.englishforeveryone.org
- www.merriam-webster.com

Aptitude

- Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT Common Admission Test", Tata Mc Graw Hills, 5th Edition , 2012

- Arun Sharma, "How to Prepare for Logical Reasoning for the CAT Common Admission Test", Tata Mc Graw Hills, 2nd Edition, 2014
- Arun Sharma, "How to Prepare for Data Interpretation for the CAT Common Admission Test", Tata Mc Graw Hills, 3nd Edition, 2015
- R.S. Aggarwal, "Quantitative Aptitude For Competitive Examinations", S. Chand Publishing, 2015
- R.S. Aggarwal, "A Modern Approach To Verbal & Non-Verbal Reasoning", S. Chand Publishing, Revised -2015
- Sarvesh Verma, "Quantitative Aptitude-Quantum CAT" , Arihant Publications, 2016
- www.mbatious.com
- www.campusgate.co.in
- www.careerbless.com

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50
Pass / Fail		

*CA - Can be **presentations, speaking activities and tests.**

ELECTIVES

24MM631 STEM CELLS AND ITS APPLICATIONS IN MEDICINE 3-0-0-3

Pre-requisites: Basic understanding of biology biotechnology
Total number of classes: 45

Preamble

Stem cells are essential in the understanding of development of a fully functional organism from a single cell and the complexities associated with it. Due to its potential ability to differentiate into different cell types, these cells have huge application in medicine with respect to developing cellular therapies patient oriented viz personal medicine level. The potential therefore in medicine and medical research is enormous.

Syllabus

Unit 1 (Lectures 3)

Introduction to stem cells, origin of thoughts on the potential of nucleus and identification on the significance of cytoplasm, history of the origin of stem cells.

Unit 2 (Lectures 8)

Journey from embryo to fetus and the role of cytoplasm in stemness. Nuclear transfer and its significance in stem cell evolution. Identification and characterization of pluripotent stem cells in animal and humans; sources of pluripotent cells – blastocysts, parthenogenesis. Evolution of induced pluripotent stem cells. Significance of cytoplasm in stemness revisited and application of molecular biology, Generation of iPSC's.

Unit 3 (Lectures 8)

Stem cell markers. Types of stem cells its advantages and disadvantages. Classification of stem cells. Normal stem cells: hematopoietic stem cells, mesenchymal stem cells, cardiac stem cells. Embryonic stem cells (ESC): difference between mouse

and human ESCs, derivation of ESCs, scientific and ethical hindrance to ESC therapy. Tissue Stem Cells, Stem cell microenvironment: Cancer stem cells, Stem cell niche and how it can be studied, its significance in signaling and drug resistance of cancer stem cell survival. Role of engineered materials in inducing stem cell drug resistance and maintenance.

Unit 4 **(Lectures 9)**

Identifying and isolating stem cells. Cancer stem cells: Historical perspective, isolation and characterization of cancer stem cells. Solid cancer stem cells (Breast, Lung, prostate, liver, stomach, Glioma). Targeting cancer stem cells. Hematological malignancies and stem cells. Side population cells in flow cytometry, Induced pluripotent stem cells, its derivation and applications.

Unit 5 **(Lectures 7)**

Proliferation and differentiation control stem cells by signalling mechanisms. The role of various stimuli and cytokines. Endothelial mesenchymal transition (EMT). EMT in fibrotic diseases and cancer.

Unit 6 **(Lectures 7)**

Translational Stem Cell Medicine, Stem cells and Gene Therapy: Signaling pathway involved in self-renewal and differentiation of stem cells. clinical use of stem cells. Molecular mechanisms controlling the stem cell survival and viability and its significance in stem cell therapy. Basic principles and methodologies in generating stem cells.

Unit 7 **(Lectures 3)**

Regulatory and ethical issues of stem cell research. Stem cell therapy for various diseases (neurodegenerative, retinal, leukemia, heart).

TEXT BOOK:

Robert Lanza, "Essentials of Stem cell Biology", Elsevier, 2006

REFERENCE:

Daniel R. Marshak, Richard L. Gardner and David Gottlieb, "Stem cell Biology", Cold spring Harbour Laboratory Press, 2001

Course Outcome

CO1 The student will be exposed to the history of stem cells, how the basic concept of stem cells has evolved over a period of 100 years.

CO2 Student will be exposed to the classification and also the major developments in stem cell biology area as well as principles and methodologies practiced.

CO3 Student will understand the concept of induced pluripotent stem cells, its derivation and differentiation to various lineages.

CO4 Student will understand the adult and embryonic stem cells and its derivations, isolation etc. Student will get clarity on the concept of stem cell niche and the concepts about cancer stem cells

CO5 At the end of this module the students will get an idea about stem cell therapy for various diseases and the ethical issues of stem cell research.

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage

PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

0 – No affinity; 1 – low affinity; 2 – Medium affinity; 3 – High affinity

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	0	0	1	0	1	0	0	0	0	0	2
CO 2	3	2	2	2	2	2	0	0	0	0	0	2
CO 3	3	3	2	2	3	2	1	1	0	0	0	3
CO 4	3	2	3	3	3	2	0	0	0	0	0	3
CO 5	3	3	3	3	3	2	1	3	0	0	0	3

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	1	1	0	0	2	0	0	2	0	0
CO 2	2	2	1	2	2	0	0	1	0	0
CO 3	1	3	0	1	3	0	0	0	0	0
CO 4	2	1	1	1	3	0	0	0	0	0
CO 5	1	2	2	1	3	0	0	0	0	0

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%

		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM632 BIOINFORMATICS AND STRUCTURE BASED DRUG DESIGN 2-0-1-3

Pre-requisites: Basic understanding of computer and biology
Preamble: Compiling and articulating mammoth of biological information is the key to development of focused research and generation of theoretical models for predicting structure and function saving valuable research-time and efforts. This course will bring the students to conceptual understanding about the significance of bioinformatics as a whole and equip them to understand this molecular highway of information towards its effective use and development of therapy in medicine.
Total number of classes: 45

Syllabus

Unit 1 **Lectures 12**

Introduction to Concept of Genomics, Proteomics and Bioinformatics; Databases on web:Genome, Proteome and Molecular biology; Sequence alignment: Near-optimal sequencealignment; Global pair wise sequence alignment; Multiple sequence alignment; Genomerearrangement; Evolutionary Bioinformatics: Phylogenetic tree construction and analysis.Different methods used for protein evolution; Protein Modeling: Protein structure prediction andanalysis, Protein visualization software, Protein dynamics and Protein structure validation tools.

Unit 2 **Lectures12**

Chemoinformatics: Basic idea of molecule design, Visualization and generation of 2D and 3Dmolecular structures, Chemical databases and its implications, Pharmacophore model, Virtualscreening, Ligand based and structure-based molecular design; Commands and Languages: BasicUnix and Linux commands, Extensible markup language and its use in Bioinformatics; Sequencesimilarity and database search: Pattern recognition and matching; Quantitative and probabilistic
pattern matching; Sequence pattern databases, Spectral pattern matching, String matchingalgorithm.

Unit 3 **Lectures 6**

Machine learning, Deep learning and Artificial Intelligence in Drug discovery; Few case studiesof integrating this methodology towards in vitro/in vivo model systems in understanding themolecular basis of the disease.

Unit 4 **Lectures 15**

Lab course work:Basic linux commands and linux editors, X-windows and linux environment used for learningdifferent linux commands and text editors like vi, xedit etc. Exposure to different usefuldatabases, virtual screening and Data mining, Different biologically important databases wereexplored. Structural similarity search of drug like molecules were mined from different smallmolecular databases. Sequence alignment studies of protein family using BLAST software.

TEXT BOOKS:

1. *Mount D W, "Bioinformatics Sequence and Genome Analysis", Cbs Publishers & Distributors (2003), ISBN: 8123909985*

2. *Jenny G and Philip E B, "Structural Bioinformatics", Second Edition, Wiley-Blackwell publisher (2011). ISBN: 978-1-118-21056-7*
3. *Practical Bioinformatics; Editors: Bujnicki, Janusz M. (Ed.), Series: Nucleic Acids and Molecular Biology, Springer publisher, 10.1007/978-3-540-74268-5, 2008.*

REFERENCES*:*

Mohan CG, "Structural Bioinformatics- Applications in Preclinical Drug Discovery Process", Springer Nature Publisher, 2019. ISBN 978-3-030-05282-9.

Course Outcome

CO1 Basic concepts on amino acids, peptide bond, Genomics basics, database analysis and structure-property relationships.
CO2 Pairwise and Multiple sequence alignment methods, algorithms and applications and understanding the sequence conservation for protein sequence-function relationships
CO3 Molecular docking, pharmacophore modeling, protein ligand complex interactions and its mechanism of action, QSAR, QSPR, QSTR techniques used in Chemoinformatics field.
CO4 Different techniques in Machine learning and deep learning, concepts taught to make awareness in molecular modeling studies. Its integration with wet lab studies will be discussed.
CO5 Skills working in Linux environment; Different linux commands and linux editor will be taught; Sequence alignment studies; Macromolecule sequence-structure and function studies and visualization using different software.

C / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1	1	-	-	-	-	-	-	1
CO 2	3	3	3	2	1	-						1
CO 3	3	3	3	2	1	-						1
CO 4	3	3	3	2	1	-						1
CO 5	3	2	2	1	1	-	-	1	2	1	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

C	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10

CO										
CO 1	3	1	1	1	1	1	-	-	-	2
CO 2	3	2	1	1	1	1	-	-	-	2
CO 3	3	2	2	1	2	1	-	-	2	3
CO 4	2	2	1	2	1	1	-	-	2	3
CO 5	3	3	2	2	2	-	-	-	1	3

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM633 Clinical Microbiology 3-0-0-3

Pre-requisites: Basic understanding of microbiology
Total number of classes: 45

Preamble
The candidates undertaking this course will gain knowledge about fundamentals of microbiology with special reference to bacterial, viral and fungal diseases; and host responses against infections. The scientific understanding developed through the course will motivate the student to take up advanced microbiology courses that has extensive application in medicine.

Syllabus

UNIT 1 **(5 lectures)**
Morphology of bacteria: Shape of bacteria, bacterial cell wall, cell membrane, cytoplasmic matrix, cell wall appendages, bacterial spores

UNIT 2 **(4 lectures)**
Physiology of bacteria: Bacterial growth and nutrition, factors affecting growth of bacteria, bacterial metabolism

UNIT 3 **(5 lectures)**
Laboratory diagnosis of bacterial infections: Specimen collection, staining techniques, culture, identification and AST, culture methods, aerobic and anaerobic methods of culture, identification of microbes, antimicrobial susceptibility testing, serology, molecular methods.

UNIT 4 **(5 lectures)**
Antimicrobial agents and antimicrobial resistance: Antimicrobial agents, antimicrobial resistance, mechanism of antimicrobial resistance.

UNIT 5 **(12lectures)**
Pathogenesis of bacterial infections: Mechanism of bacterial pathogenesis, route of transmission, infective dose, intracellular survival, toxins, overview of bacterial infections.

UNIT 6 **(5 lectures)**
General Virology: Morphology of viruses, viral replication, pathogenesis of viral infections, isolation and cultivation of viruses, treatment of viral diseases, viral vaccines

UNIT 7 **(4 lectures)**
Overview of viral infections: Herpers viruses, other DNA viruses, Myxoviruses, Rubella, Corona, Picornaviruses, Arboviruses, Rabies, HIV, Hepatits.

UNIT 8 **(2 lectures)**
General Mycology: Classification of fungi, laboratory diagnosis of fungal infections, treatment of fungal infections, overview of fungal infections.

UNIT 9 **(2 lectures)**
Healthcare associated infections: Catheter associated infections, surgical site infections

UNIT 10 **(1 lectures)**
Sterilization and disinfection: Sterilants, high level intermediate level and low level disinfectants, cleaning agents, chemical and biological indicators.

Course Outcome

CO1 Students will develop a comprehensive understanding of the morphology, physiology, and growth dynamics of bacteria, viruses, and fungi, including their cellular structures, growth requirements, and metabolic pathways.

CO2 Students will acquire proficient laboratory skills in diagnosing microbial infections, including specimen collection techniques, staining procedures, culture methods, and antimicrobial susceptibility testing, utilizing both conventional and molecular techniques.

CO3 Students will learn to critically evaluate antimicrobial agents, understand mechanisms of antimicrobial resistance, and apply strategies for the effective management and control of antimicrobial resistance in clinical settings.

CO4: Students will gain an in-depth understanding of microbial pathogenesis, transmission routes, infective doses, and virulence factors contributing to bacterial, viral, and fungal infections, and will be equipped with infection control measures to mitigate their spread in healthcare settings.

CO5: Students will demonstrate competence in selecting and implementing appropriate sterilization and disinfection protocols, including knowledge of sterilants, disinfectants, cleaning agents, and biological indicators, to ensure the prevention of healthcare-associated infections and maintain aseptic environments.

TEXT BOOK:

1. Essentials of Medical Microbiology By Apurba S Sastry, Sandhya Bhat
Edition: 4th; Publisher: Jaypee Brothers; Year: 2023; ISBN: 9789356963320
2. Prescott's Microbiology 11th Edition.

PO1: Bioscience Knowledge

PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

Program Specific Outcomes. (PSO)

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1	-	-	-	-	-	-	-	1
CO 2	3	1	1	-	-	-	-	-	-	-	-	1
CO 3	3	1	1	-	-	-						1
CO 4	3	1	1	1	-	-	-	-	-	-	-	1
CO 5	3	1	1	1	1	-	-	-	-	-	-	1

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	1	2	-	-	3	-	-	1	-
CO 2	3	-	1	-	-	-	-	-	-	-
CO 3	3	1	1	-	1	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-
CO 5	3	-	3	-	2	-	-	-	-	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%

Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MMD634 Organ Systems Physiology 3-0-0-3

Pre-requisites: Undergraduate level basic biology
Total number of classes: 45

Preamble: This course builds on basic physiology and delves into individual organ systems, their design, structure, and function. Each organ system will be discussed from a perspective of its function and how tissue and cellular hierarchies, in terms of their architecture and processes, contribute to organ system homeostasis. Current progress in terms of biomedical advancement in each organ system will also be explored.

Syllabus

Unit 1 (Lectures 5)
Introduction, body water and distribution, regulation of water within extracellular, transcellular, and intracellular compartments, determination of compartmental fluid volumes, electrolyte distribution and their role in cell membrane potential

Unit 2 (Lectures 4)
Blood and its components, serum, plasma, the coagulation process and dyscrasias, advancement in blood substitutes and their principle, and the lymphatic system

Unit 3 (Lectures 6)
Cardiovascular system and the vascular tree, cardiac electrophysiology, arrythmias, pressure and volume changes in the ventricular chambers, cardiac cycle, valve kinetics, cardiac muscle physiology and calcium regulation, and cardiac biomedical technology

Unit 4 (Lectures 4)
Pulmonary system, mechanics of ventilation, bronchial and alveolar cell functions, pulmonary function tests and assisted respiration technology

Unit 5 (Lectures 6)
Hepatobiliary system, pancreas and the gut, hepatocyte architecture and function, blood-bile dynamics, pancreatic acini function, advancement in artificial liver and pancreas development, and gut physiology

Unit 6 (Lectures 5)
Renal physiology, function of nephron, process of urine formation, pressures across the Bowmans membrane, and developments in body fluid dialysis

Unit 7 (Lectures 10)

Nerve function, introductory neurophysiology, synapse physiology, neural circuits, signal processing in the special sense organs, cognition, and brain machine interface

Unit 8 **(Lectures 5)**

Reproductive and endocrine system, hormonal axis, and regulation in various endocrine glands

TEXT BOOK:

John E. Hall, "Guyton and Hall Textbook of Medical Physiology", 13e Elsevier, 2015

Program Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	1	-	-	-	3	2	-	1
CO2	3	3	1	-	1	-	-	-	3	2	-	1
CO3	3	3	3	-	1	-	-	-	3	2	-	1
CO4	3	2	1	-	1	-	-	-	3	2	-	1
CO5	2	1	3	2	1	3	-	2	3	2	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
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PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	-	-	-	-	-	-	-	-
CO2	3	3	-	-	2	-	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-
CO5	3	1	2	2	2	-	1	2	-	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	**Exam**	**20%**
Periodical 2	**Exam**	**20%**
Continuous Assessment	**Assignment/Test/Quiz**	**10%**
		50%
End Semester Examination- 50%		
Theory Exam	**50%**	
		50%
	Total	**100%**

SECOND SEMESTER

24MM611 IMMUNOLOGY 3 0 0 3

Preamble

This course is designed to provide a comprehensive understanding of both fundamental and applied aspects of immunology. Successful completion of this course will foster a deep appreciation for the dynamic and multifaceted field of immunology, equipping the students with the knowledge and skills essential for both academic exploration and practical applications in various domains of science and medicine.

LECTURE WITH BREAKUP:

Unit 1 **3 lectures**

Basic Concepts in Immunology, Cells and organs of the immune system, Principles of Innate and Adaptive Immunity

Unit 2 **5 lectures**

Innate Immunity: Recognition and effector mechanisms, Inflammation and its regulation, Complement system.

Unit3 **6 lectures**

Adaptive Immunity: Antigen recognition and processing, B and T cell development and activation, Immune memory, Antigen Recognition by B-cell and T-cell Receptors

Unit 4 **5 lectures**

The Generation of Lymphocyte Antigen Receptors, the generation of diversity in immunoglobulins, T-cell receptor gene rearrangement, Structural variation in immunoglobulin constant regions.

Unit 5 **6 lectures**

The development and survival of Lymphocytes: Generation of lymphocytes in bone marrow and thymus, the rearrangement of antigen-receptor gene segments controls lymphocyte development, interaction with self-antigens selects some lymphocytes for survival but eliminates others, survival and maturation of lymphocytes in peripheral lymphoid tissues.

Unit 6 **5 lectures**

T cell-mediated immunity: Production of armed effector T cells, General properties of armed effector T cells, T cell-mediated cytotoxicity, Macrophage activation by armed CD4 TH1 cells.

Unit 7 **5 lectures**

Immunopathology: Autoimmunity, Allergy and hypersensitivity, Immunodeficiency disorders

Unit 8 **5 lectures**

Immunotherapy and Vaccines: Monoclonal Antibodies: Production and Applications, Adoptive Cell Therapy and Immunomodulation, Vaccine Development and Immunization Strategies, Currently available vaccines. Immunotherapy in Autoimmune Diseases and Cancer

Unit 9 **5 Lectures**

Immunological Diagnostics: Serological Techniques: ELISA, Western Blotting, Flow Cytometry and
Immunophenotyping, Molecular Diagnostics in Immunology, Point-of-Care Testing in Immunodiagnostics

Course Outcomes

CO1
Develop a comprehensive understanding of immunology by encompassing both innate and adaptive immune systems, focusing on fundamental concepts.
CO2
Recognize and understand the crucial cells and organs of the immune system, exploring their roles in immune responses.

CO3
To understand how innate and adaptive immunity work, applying their principles to bolster host defence

CO4
To learn about the mechanisms driving diversity in immunoglobulins and the rearrangement of T-cell receptor genes.

CO5
To learn about the intricate processes guiding the development and survival of lymphocytes, including their formation in the bone marrow and thymus.

CO6
To understand the humoral immune response, including B-cell activation, functions of immunoglobulin types, and how pathogens are destroyed through Fc receptors.

CO7
To understand the mechanisms underlying autoimmune conditions, allergies, hypersensitivity, and immunodeficiency disorders.

CO8
To acquire comprehensive knowledge in advanced immunological diagnostics, cutting-edge applications in immunotherapy and vaccines, insights into immunology's role in infectious diseases, and an understanding of immune response manipulation.

TEXT BOOK:

1. Janeway's Immunobiology, Ken Murphy, Paul Travers, Mark Walport, 9th edition.

REFERENCES:

1. Kuby Immunology" by Judy Owen, Jenni Punt, and Sharon Stranford , 2018
2. Clinical Immunology: Principles and Practice" by Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry W. Schroeder, Jr., and Anthony J. Frew, 2018

1. Course Outcome

CO1 Knowledge about the microorganisms, basic skills in aseptic/sterilization techniques, antimicrobial agents and microbial diseases. Students will learn the composition of human microbiome and their role in maintaining normal gut function.
CO2 Will gain knowledge about principles of innate and adaptive immune system, the antigen receptor structure and the mechanisms of antigen recognition by B-cell and T-cells.
CO3 Gain knowledge about immune signal mechanisms, lymphocyte generation, B- and T-cell receptor gene rearrangements; and lymphocyte development.
CO4 Will gain knowledge about macrophage and B cell activation by T cells, adaptive Immunity to Infection: immunological memory. Failures of Host Defense Mechanisms, immunodeficiency diseases, acquired immune deficiency syndrome.
CO5 Gain knowledge about the mechanism of allergic responses, hypersensitivity reactions, autoimmunity and transplantation. The students will also learn about the importance for immunization and manipulation of the immune system to fight infectious disease.
PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

c / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1	-	-	-	-	-	-	-	1
CO 2	3	1	1	-	-	-	-	-	-	-	-	1
CO 3	3	1	1	-	-	-						1
CO 4	3	1	1	1	-	-	-	-	-	-	-	1
CO 5	3	1	1	1	1	-	-	-	-	-	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	1	2	-	-	3	-	-	1	-
CO 2	3	-	1	-	-	-	-	-	-	-
CO 3	3	1	1	-	1	-	-	-	-	-
CO 4	3	-	1	-	-	-	-	-	-	-
CO 5	3	-	3	-	2	-	-	-	-	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM612 CLINICAL BIOCHEMISTRY AND PROTEOMICS 3-0-0-3

Pre-requisites: Basic understanding of biology, chemistry and biotechnology
Total number of classes: 45
Preamble
The course intends to provide a basic understanding of the biochemical reactions; role of macromolecules and enzymes that govern the biochemical transformations and biochemical mechanisms responsible for common biochemical disorders; mass-spectrometry based proteomics for protein identification and quantitation, application of proteomics in the clinics for aiding in diagnosis, prognosis and treatment of diseases.

Syllabus
Unit 1 **10 lectures**

Biochemical mechanisms leading to generation of essential biological molecules for cellular architecture generation and preservation for maintaining cellular physiology. Significance of carbohydrate and fatty acid metabolism in this process. Glycolysis; TCA cycle, Oxidative Phosphorylation - Energetics and its regulation; Cori cycle; Glycogen Metabolism; Pentose phosphate pathway; Gluconeogenesis pathway and significance; Biosynthesis of fatty acids; Oxidation of fatty acids - Beta oxidation, alpha oxidation.

Unit 2 **6 lectures**

Structures & function of enzymes, mechanism of action of enzymes and its regulation; Kinetics of enzyme catalyzed reactions, Michaelis-Menten equation, Importance of Vmax, Km; Enzyme inhibition and activation.

Unit 3 **9 lectures**

Concept and scope of clinical biochemistry; Control of the blood glucose and associated clinical diseases; Reference range.

Unit 4 **12 lectures**

Proteome and proteomics research, how it is different from genomics; different types of proteomics, significance of sample preparation in proteomics, significance of choosing different methods for proteome analysis, gel-free and gel-based proteome analysis, labelled and label-free quantitative proteomics.

Unit 5 **8 lectures**

Mass spectrometry and its significance in modern science and medicine. Principles of mass spectrometry; protein identification using mass spectrometry, protein fragmentation; peptide enrichment and separation; ionization and its importance; Time of Flight, MS/MS analysis, types of mass analyzers, peptide fragmentation and peptide sequencing; identification of proteins using search engines/programs; accuracy of identified proteins with respect to protein identity, significance of mass spectrometry in clinics, clinical proteomics and examples of clinical proteomics

TEXT BOOKS:

1. Fundamentals of Biochemistry: Life at the Molecular Level Kindle Edition by Donald Voet (Author), Judith G. Voet (Author), Charlotte W. Pratt (Author) 5th edition 2016

2. Nawin C. Mishra, "Introduction to Proteomics: Principles and Applications" Wiley, 2010, ISBN: 0471754021

REFERENCE:

Lehniger Principles of biochemistry 8th Edition (2021), Publisher: WH Freeman, Authors Michael Cox, David L. Nelson.

Course Outcome

CO1: Understand overall concept of cellular metabolism, energy storage and release, enzymes and their regulation

CO2: Understand glucose homeostasis (pathways and hormonal regulation); glycogen metabolism, gluconeogenic pathway, fat metabolism.

CO3: Understand the basic concepts and principles of clinical biochemistry and molecular mechanism of some common biochemical disorders

CO4: Understand the basic concepts of proteome, mass spectrometry and protein identification using database search engines.

CO5: Discuss how proteomics can contribute to a clinical setting.

Program Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	-	-	-	-	-	-	1
CO2	3	1	1	-	-	-	-	-	-	-	-	1
CO3	3	2	1	2	-	2	-	-	-	-	-	1
CO4	3	1	2	2	3	-	-	-	-	-	-	1
CO5	3	1	2	3	3	2	-	-	-	-	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	1	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-
CO3	1	3	3	2	1	-	-	-	-	-
CO4	-	1	1	3	-	-	-	-	-	3
CO5	-	2	1	3	-	-	-	-	-	3

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM613 GENETICS: PRINCIPLES AND ANALYSIS 3-0-0-3

Pre-requisites: Basic understanding of biology and genetics
Total number of classes: 45

Syllabus

Unit-1 Lectures 3
Overview of genetics: Relationship between genes and traits, Fields and science of genetics; Patterns of inheritance: Mendelian inheritance, Law of segregation, Law of independent assortment, Studying inheritance patterns in humans;

Unit-2 Lectures 8
Extensions of Mendelian inheritance: Overview of simple inheritance patterns, Dominant and recessive alleles, Environmental effects on gene expression, Incomplete dominance, overdominance and codominance, X-linked inheritance, Sex-influenced and sex-limited inheritance, Lethal alleles, Pleiotropy, Gene interactions, Non-Mendelian inheritance: Maternal effect, Epigenetic inheritance-dosage compensation and genomic imprinting, Extranuclear inheritance;

Unit-3 Lectures 9
Chromosomes of eukaryotes: Chromosome organization and molecular structure: General features of chromosomes, Organization sites along eukaryotic chromosomes; Chromosome transmission during cell division and sexual reproduction: Chromosomes during cell divisions - mitosis and meiosis, The chromosome theory of inheritance and sex chromosomes; Genetic linkage and mapping in eukaryotes: Overview of linkage, Relationship between linkage and crossing over, Genetic mapping in animals, Mitotic recombination; Variation in chromosome structure and number: Changes in chromosome structure - an overview, Deletions and duplications, Inversions and translocations, Changes in chromosome number - an overview, Variation in number of chromosomes within a set and in the number of sets of chromosomes;

Unit-4 Lectures 9
Gene regulation in eukaryotes: Epigenetics: Epigenetics and development, Paramutation, Epigenetics and environmental agents, Role of epigenetics in cancer; Noncoding RNAs: Overview, Effects of noncoding RNAs on chromatin structure, transcription, translation, mRNA degradation and RNA modifications, Noncoding RNAs in protein targeting and genome defense, Role of noncoding RNAs in human diseases;

Unit-5 Lectures 8
Medical, immuno and developmental genetics: Medical genetics: Inheritance patterns of genetic diseases, Genetic basis of cancer, Personalized medicine; Immunogenetics: Genetics of V(D)J recombination and antibody diversity; Developmental genetics: Genetics of vertebrate development, differential gene expression and its role in development;

Unit-6 Lectures 8
Population and evolutionary genetics: Genes in populations and the Hardy-Weinberg equation, Overview of microevolution, Natural selection, Genetic drift, Migration, Nonrandom mating, Sources of new genetic variation; Complex and quantitative traits: Overview of complex and quantitative traits, Polygenic inheritance, Heritability,

Selective breeding; Evolutionary genetics: Origin of species, Phylogenetic trees, Molecular evolution.

TEXT BOOKS:
Genetics: Analysis and Principles, 6th edition, Robert Brooker, McGraw-Hill Professional publishers, 2017.

REFERENCE
Principles of genetics, 8th edition, Gardner, Simmons, Snustad, Wiley, 2006.

Course Outcome
CO1 To understand patterns of inheritance and laws of heredity at molecular levels
CO2 To understand about chromosomes and their transmission during cell divisions, genetic linkage and mapping in Eukaryotes, variations in chromosome structure and number, and chromosome organization and molecular structure
CO3 To comprehend various modes of epigenetic regulation on gene expression in Eukaryotes and roles of noncoding RNA in gene regulation
CO4 To learn about genetic principles underlying medical, immune and developmental aspects
CO5 To gather knowledge of complex and quantitative traits, polygenic Inheritance, population genetics, phylogenic trees and molecular evolution

Program Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

0 – No affinity; 1 – low affinity; 2 – Medium affinity; 3 – High affinity

c / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	2	2	3	0	0	0	0	3
CO 2	3	2	2	2	2	3	3	0	0	0	0	3
CO 3	3	2	2	2	3	3	3	0	0	0	0	3
CO 4	3	1	1	2	3	3	3	0	0	0	0	3
CO 5	3	3	3	3	2	3	3	0	0	0	0	3

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

C / C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	1	3	2	1	0	0	0	0	1
CO 2	3	1	3	3	3	0	0	3	0	3
CO 3	3	3	3	3	2	0	0	2	0	3
CO 4	3	2	3	3	1	0	0	2	3	0
CO 5	3	2	2	3	0	0	0	0	0	3

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	**Exam**	**20%**
Periodical 2	**Exam**	**20%**
Continuous Assessment	**Assignment/Test/Quiz**	**10%**
		50%
End Semester Examination- 50%		
Theory Exam	**50%**	
		50%
	Total	**100%**

24MM682 IMMUNOLOGY AND MICROBIOLOGY LAB 1-0-1-2

Pre-requisites: Basic understanding of biology and biochemistry and immunology
Total number of classes:30

Preamble:
Students will be familiarized with the basics as well as advanced methods in microbiology and immunology that can be used for disease diagnosis. Provide hands-on training for isolation of microbes in pure culture and antibiotic susceptibility assays. Provide the students with practical skills on lymphocyte isolation and analysis.
Practicals:
Experiment 1: Observation & Identification of Immune Cells,
Experiment 2: Observation and identification of the structure of lymphoid organs,

Experiment 3: Blood grouping,
Experiment 4: Separation of Mononuclear cells using density gradient centrifugation,
Experiment 5: Isolation of Monocytes from the Mononuclear Cells,
Experiment 6: Induction of Monocytes to M1 and M2 Macrophages,
Experiment 7: Evaluation of inflammatory and anti-inflammatory cytokines produced by M1 and M2 macrophages through ELISA.
Experiment 8: Bacterial and fungal culture medium preparation,
Experiment 9: Pure culture technique (eg: streaking and sub culturing),
Experiment 10: Gram staining, Fungal staining, Motility assay
Bacterial growth curve by measuring turbidity and viable count
Experiment 11: Antibiotic sensitivity assay; MIC and MBC determination,
Experiment 12: Biofilm assay, MBIC and MBEC determination,
Experiment 13: Phage titration assay

TEXT BOOKS:

1. Practical Handbook of Microbiology- Lorrence H Green, Emanuel Goldman by CRC Press, 4th Edition, ISBN 9780367567637
2. Practical Immunology-Frank C. Hay, Olwyn M.R. Westwood, Fourth Edition,Blackwell Science.

Course Outcomes

CO1 Provide the students the knowledge about practical skills on basic microbiology.
CO2 Students will learn about different antimicrobial activity assays.
CO3 Students will develop an understanding about components of immune system and their function.
CO4 The students will learn about mutagenic assays, biofilm assays and blood grouping.
CO5 The students will learn about different antigen and antibody interaction assays.

Program outcome

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

c / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	1	1	-	-	1	1	1	-	3
CO 2	3	3	1	1	1	-	-	1	-	1	-	3

CO 3	3	1	1	1	1	-				1		3
CO 4	3	3	1	1	1	-	-	-	-	1	-	3
CO 5	3	3	1	1	1	-	-	1	1	1	-	3

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	3	1	2	2	-	3	-	-	1	-
CO 2	3	-	1	2	-	-	-	-	1	-
CO 3	3	1	1	2	1	-	-	-	-	-
CO 4	3	-	1	2	-	-	-	-	-	-
CO 5	3	-	3	2	2	-	-	-	-	-

Evaluation Pattern: 30+70 = 100

Internal Assessment – 30%		
Records	Evaluation	30%
		30%
End Semester Examination- 50%		
Practical	Exam	60%
Assessment	Viva	10%
		70%
	Total	**100%**

24MM683 BIOCHEMISTRY LAB 1-0-1-2

Pre-requisites: Basic understanding of biology and chemistry
Total number of classes: 30

Syllabus:

Experiment 1: Preparation of different concentrations of laboratory Reagents, pH measurement.

Experiment 2: Protein estimation: Lowry method and spectrometry principles.

Experiment 3: Protein estimation: Biuret method / Bicinchoninic acid

Experiment 4: Enzyme Estimation (Serum Amylase) - Iodometric Method

Experiment 5: Amino acid Estimation by Biuret Test, Millon's Test, Hopkin's Cole Test, Xanthoproteic Test, Lead Acetate Test

Experiment 6: Protein Separation by SDS-PAGE and Western Blotting.

Experiment 7: Chromatographic techniques (Eg., Thin Layer chromatography or high performance liquid chromatography (HPLC)

TEXT BOOKS:

1. *D. T. Plummer. An Introduction to Practical Biochemistry, McGraw Hill Education; 3rd edition, 2017.*
2. *Rodney Boyer. Biochemistry laboratory: Modern Theory and Techniques (2nd Edition), Pearson, 2011.*
3.

REFERENCES

1. *S. Chaykin Biochemistry Laboratory Techniques, 169pages. John Wiley & Sons Inc., blew York.*

Course Outcome

CO1: Understand the basics of the measure of solution concentration
CO2: Understand the importance of protein estimation, different types of protein estimation (Eg., Lowry method, Biuret method etc)
CO3: Understand how to quantify enzyme level in serum (amylase enzyme)
CO4: Determine the presence of amino acids in a given sample and know the advantages / disadvantages of different method of detection.
CO5: Evaluate separation of proteins in the sample by sodium dodecyl sulfate–polyacrylamide gel electrophoresis and chromatographic techniques

Program outcome

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	2	3	2	-	2
CO2	3	3	2	1	1	-	-	2	3	2	-	2
CO3	3	3	2	1	1	-	-	2	3	2	-	2
CO4	3	3	2	1	3	-	-	2	3	2	-	2
CO5	3	3	2	1	2	-	-	2	3	2	-	2

Program Specific Outcomes (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
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PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	-	2	-	-	-	-	-	-	-	-
CO2	1	2	2	2	-	-	-	-	-	-
CO3	1	2	2	2	-	-	-	-	-	-
CO4	1	2	2	2	-	-	-	-	-	-
CO5	1	2	2	2	-	-	-	-	-	-

Evaluation Pattern: 30+70 = 100

Internal Assessment – 30%		
Records	Evaluation	30%
		30%
End Semester Examination- 50%		
Practical	Exam	60%
Assessment	Viva	10%
		70%
	Total	**100%**

ELECTIVES

24MM641 DRUG DELIVERY PHARMACOKINETICS AND PHARMACODYNAMICS 3-0-0-3

Pre-requisites: Basic level biology and biochemistry
Total number of classes: 45

Preamble: This course introduces the student to basic principles of pharmacokinetics and pharmacodynamics, along with an introduction to the main drug categories. The central focus of this course is to help students understand how concentration of a drug changes in various body compartments and the factors regulating that change. Students will also be exposed to topics related to the mechanisms of drug action, with suitable and appropriate examples.

Syllabus

Unit-1 **(8 lecture)**

Fundamental concepts of drug delivery: Physicochemical Properties of Drugs, Effects of fundamental physicochemical properties on the biopharmaceutical behavior of drugs, Concentration-time curve of pharmacokinetics; Fundamentals of controlled drug delivery, Pharmacokinetic and pharmacodynamic basis of controlled drug delivery, Physicochemical and biological factors influencing design and performance of controlled release products.

Unit-2 **(15 lecture)**

Routes of Drug Delivery: Enteral – Oral, Sublingual, Buccal, Rectal; Parenteral – Intravenous, Intramuscular, Intra-arterial, Intra-thecal, Intradermal; Topical – Transdermal, Intranasal, Conjuctival; Conventional drug delivery systems; Concept of active and passive targeting of drugs

Unit-3 **(15 lecture)**

Introduction to pharmacokinetics; Route of administration of drugs; Pharmacokinetic Parameters – bioavailability, biological Half-life, volume of distribution and clearance; Absorption of drugs; Mechanism of drug absorption; Factors affecting drug absorption; Distribution of drugs; Protein binding of drugs; Factors affecting distribution of drugs; Metabolism of drugs; Excretion of drugs; Kinetic models

Unit-4 **(7 lecture)**

Introduction to pharmacodynamics, drug-receptor interaction, body compartment systems, Drug Action – Action and effect, Excitation and Inhibition, Selectivity of drug action, Therapeutic effect and adverse reaction, Principles of Drug action- Dose effect relationship, Time effect relationship, structure activity relationship,Mechanism of drug action- Simple physical and chemical property, involving or interfering physiological and biochemical process of living system.

TEXT BOOKS / REFERENCES:

1. Robert E. Notari; Biopharmaceutics and Clinical Pharmacokinetics: An Introduction, Fourth Edition, 2017
2. Leon Shargel, Susanna Wu-Pong, Andrew Yu; Applied Biopharmaceutics & Pharmacokinetics 5th edition, McGraw-Hill Medical 2004
3. Rowland and Tozer, Clinical Pharmacokinetics: Concepts and Applications, 1995.
4. Drug Delivery: Fundamentals and Applications, Second Edition, CRC Press 2017.
5. Drug Delivery Systems, Pieter Stroeve and Morteza Mahmoudi, World Scientific Series: From Biomaterials towards Medical Devices, Vol I, 2018.
6. Rosenbaum SE, editor. Basic pharmacokinetics and pharmacodynamics: An integrated textbook and computer simulations. John Wiley & Sons; 2016.

Course Outcome

CO1: Be able to articulate the drug-intrinsic and extrinsic factors that determine drug molecule movement across biological membranes

CO2: To demonstrate understanding in concepts that determine dosage, absorption, distribution, and excretions of drugs, along with model systems connected with these concepts and apply pharmacokinetic principles to explain variation in drug disposition

CO3: To demonstrate ability to describe functional outcome of drugs due to drug-cell interactions
CO4: To demonstrate understanding of signaling pathways that link drug-receptor interaction and cell response, along with an understanding of toxicological response and ways to quantify and describe drug-induced toxic effects
CO5: Be able to work with a team and put together in depth information related to PKPD concepts in a web-platform

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	1	-	-	-	-	-	-	3	-	-	-
CO2		3	3	2	3	-	-	2	-	3	-	-	-
CO3		3	3	2	-	-	-	-	-	3	-	-	-
CO4		3	2	-	-	-	-	-	-	3	-	-	-
CO5		2	1	-	-	3	2	-	3	3	2	-	-

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
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PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	-	-	-	2	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	3	-
CO3	3	1	1	-	2	-	-	-	3	-
CO4	3	1	1	-	-	2	-	-	3	1
CO5	1	1	1	-	1	-	-	-	2	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%

Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

Course Outcome

CO1: Be able to articulate the drug-intrinsic and extrinsic factors that determine drug molecule movement across biological membranes
CO2: To demonstrate understanding in concepts that determine dosage, absorption, distribution, and excretions of drugs, along with model systems connected with these concepts and apply pharmacokinetic principles to explain variation in drug disposition
CO3: To demonstrate ability to describe functional outcome of drugs due to drug-cell interactions
CO4: To demonstrate understanding of signaling pathways that link drug-receptor interaction and cell response, along with an understanding of toxicological response and ways to quantify and describe drug-induced toxic effects
CO5: Be able to work with a team and put together in depth information related to PKPD concepts in a web-platform

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
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PO4: Conduct Investigations of complex problems
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PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	1	-	-	-	-	-	-	3	-	-	-
CO2		3	3	2	3	-	-	2	-	3	-	-	-
CO3		3	3	2	-	-	-	-	-	3	-	-	-
CO4		3	2	-	-	-	-	-	-	3	-	-	-
CO5		2	1	-	-	3	2	-	3	3	2	-	-

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy

PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	-	-	-	2	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	3	-
CO3	3	1	1	-	2	-	-	-	3	-
CO4	3	1	1	-	-	2	-	-	3	1
CO5	1	1	1	-	1	-	-	-	2	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM642 REGENERATIVE MEDICINE & TISSUE ENGINEERING 3-0-0-3

Pre-requisites: Undergraduate level biology, biotechnology and physiology
Course code:
Course name: REGENERATIVE MEDICINE & TISSUE ENGINEERING
Credits: 3
Pre-requisites: Undergraduate level basic physics, chemistry and biology
Total number of classes: 45

COURSE OUTCOMES:
Upon successful completion, students will have the

- *Understanding on the molecules and signalling pathways that regulate epithelial and mesenchymal states of tissues and cell – extracellular matrix interactions*
- *Knowledge on the various types and sources of stem cells and their role in tissue growth, repair and regeneration*
- *Understanding on the importance of vascularisation and the challenges associated with establishing vascularisation in tissue engineered constructs*
- *Knowledge on the inherent regenerative mechanisms in human body*
- *Knowledge on the therapeutic applications of cells, and cells derived products in regenerative medicine*

LECTURE WITH BREAKUP:
Unit-1 **9 Lectures**

Biologic and Molecular Basis for Regenerative Medicine: Current perspectives in Regenerative Medicine; Types of Tissues; Molecular organisation of cells; Extracellular Matrix; Cell-extracellular matrix interactions

Unit-2 **9 Lectures**

Cellular aspect of Regenerative Medicine: Stem cells and progenitors; Types of stem cells, Embryonic stem cells, induced pluripotent stem cells, Mesenchymal stem cells, Hematopoietic stem cells, Adult stem cells

Unit-3 **12 Lectures**

Different Stages of Tissue Regeneration: Basic cell structure and functions; Tissue organisation and functions; Organ structure and functions, Scar and Regeneration; Different stages of regeneration - Hemostasis, Inflammation, Proliferation, Angiogenesis, Remodelling; Case studies - Skin regeneration, Bone regeneration, Liver regeneration.

Unit-4 **15 Lectures**

Tissue Engineering: Relevance of tissue engineering; Triad of Tissue engineering - Scaffolds Types (Ceramics, Polymers, Composites Biomimetic scaffold); Cells, Growth factors; Case *Studies:* Ectoderm derived tissues (*Nerve tissue, Cornea),* Endoderm derived tissues (Liver, Pancreas), Mesoderm (Bone, Cartilage, Muscle, blood vessels, ligament, Tendon). Recent advances in biofabrication; 3D bioprinting

TEXT BOOK

Principles of Regenerative Medicine, Anthony Atala, Robert Lanza James, Thomson Robert Nerem, 2nd Edition, Elsevier -2010

REFERENCES:

1. Ying Deng and Jordan Kuiper, Functional 3D Tissue Engineering Scaffolds: Materials, Technologies, and Applications (Woodhead Publishing Series in Biomaterials), 2017

2. *Cato T. Laurencin, Lakshmi S. Nair. Nanotechnology and Regenerative Engineering: The Scaffold, Second Edition, CRC Press 2017*

COURSE OUTCOMES:

Upon successful completion, students will have the

CO1. Understanding on the molecules and signalling pathways that regulate epithelial and mesenchymal states of tissues and cell-extracellular matrix interactions

CO2. Knowledge on the various types and sources of stem cells and their role in tissue growth, repair and regeneration

CO3. Knowledge on the inherent regenerative mechanisms in human body

CO4. Understanding on the fundamental aspects of tissue engineering and their application in developing various tissues.

Program Outcome

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work

PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

3 = High Affinity, 2 = Medium Affinity, 1 = Low Affinity, - = No Affinity

C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	-	1	1	-	-	-	-	-	2
CO 2	3	1	1	-	1	1	-	3	1	-	-	2
CO 3	3	1	2	3	1	1	-	1	1	-	-	2
CO 4	3	1	3	3	3	1	-	1	1	-	-	2

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	3	1	-	-	3	-	1	3	-	-
CO 2	-	2	-	-	3	-	-	3	-	-
CO 3	2	2	-	-	3	-	-	3	-	-
CO 4	2	2	-	-	3	-	2	3	3	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM643 RECOMBINANT DNA TECHNOLOGY 3-0-0-3

Pre-requisites: Undergraduate level basic biology, biotechnology
Total number of classes: 45
Syllabus

Unit 1 (5 Lectures)
Restriction enzymes and cloning vectors: Host controlled restriction modification, Restriction endonucleases - types and classification, modifying enzymes used in molecular cloning - methylases, polymerases, ligases, kinases, phosphatases and nucleases,

Unit 2 (10 Lectures)
Vectors and Hosts: Vectors for cloning, expression vectors (plasmids, lambda phage vectors, cosmids, BAC & YAC); Host organisms used in r-DNA technology: E. coli, Yeast, Insect cells as model organisms.

Unit 3 (10 Lectures)
Cloning, Construction of Genomic and cDNA libraries: Introduction to cloning (conventional & recombination based: traditional cloning, TA cloning, Gateway cloning etc), vGene transfer techniques: Transformation, transfection and transduction, Strategies for construction of genomic libraries, Strategies for construction of cDNA libraries.

Unit 4 (10 Lectures)
Selection and characterization of recombinant clones: Genetic Selection- insertional inactivation and alpha complementation, Labeling of nucleic acids, Immunological probes, Selection of recombinant clones-hybridization techniques, colony hybridization & library screening, hybrid arrest & hybrid release translation, DNA sequencing methods, DNA arrays.

Unit 5 (10 Lectures)
Advanced techniques and applications: Genome editing- CRISPR-Cas system, TALENs &amp ZFNs, Site directed mutagenesis and RNA interference, Recombinant vaccines, Recombinant antibodies (Fab, scFv, sdAb), Disease diagnosis, Gene therapy- technologies, applications and regulations Next generation sequencing- principle, types and applications.

TEXT BOOKS:

1. *Principles of Gene Manipulation, Sandy B. Primrose, Richard Twyman, Bob Old, Wiley, 08-Feb-2002*
2. *From Genes to Genomes: Concepts and Applications of DNA Technology. Jeremy W Dale and Malcom von Schantz 2002 John Wiley & Sons, Ltd.*

REFERENCE

1. *Gene Therapy Technologies, Applications and Regulations: From Laboratory to Clini. Anthony Meager 1999 John Wiley & Sons, Ltd.*

Course Outcome

CO1 Understand the fundamentals of molecular cloning
CO2 Understand the technical know-how on versatile techniques in recombinant DNA technology.
CO3 Gain knowledge of tools and strategies used in molecular cloning
CO4 Understand how to select and characterize recombinant clones
CO5 Understand basic and advanced molecular cloning concepts, applications and techniques

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

C C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	-	2	-	2	-	-	2	-	-	-	2
CO 2	3	1	2	2	3	-	-	-	-	-	-	1
CO 3	3	2	1	1	3	2	-	-	-	-	-	1
CO 4	3	2	3	3	-	1	-	-	-	-	-	1
CO 5	3	-	-	2	3	1	-	-	-	-	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	-	-	-	3	1	2	-	-	-	1
CO 2	-	-	-	3	-	_	-	-	-	1
CO 3	-	-	-	3	2	1	-	-	-	1
CO 4	-	-	-	3	-	-	-	-	-	-

CO 5	-	-	-	3	-	-	-	-	-	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM644 MOLECULAR BASIS OF DISEASES 3-0-0-3

Pre-requisites: Basic understanding of biology and biochemistry
Total number of classes: 45
Preamble: This course is primarily designed to help students understand the molecular mechanism behind disease processes. The idea is to use specific examples of disease conditions that are globally prevalent and effects large populations worldwide. These chosen diseases will be used to study and understand disease manifestation, progress, and outcome, based on molecular mechanisms at the tissue and cellular level. This course utilizes an active learning strategy where students and the instructor will discuss recent developments in molecular pathogenesis of the specific diseases, based on published articles.

Syllabus

Unit 1 (Lectures 3)
Introduction to disease pathogenesis, clinical terminologies, concept of prognosis, evidence-based treatment approach, bench-to-bedside approach in medicine, and introduction to a holistic approach in treating diseases

Unit 2 (Lectures 6)
The process of growth, differentiation and cell death and its molecular organization in cellular homeostasis and diseases such as cancer, neurodegenerative diseases and diabetes. Significance of molecular changes in controlling a normal homeostasis condition compared to disease.

Unit 3 (Lectures 6)
Pathological changes in diseases such as cancer, neurodegenerative diseases, autoimmune diseases and diabetes. The role of molecules and molecular changes in the pathological manifestation of disease.

Unit 4 (Lectures 7)
Significance of environmental chemicals in modifying normal homeostasis and leading to pathological changes at molecular level by controlling different signaling mechanisms. Significance of epidemiology, etiology in pathogenesis of diseases

Unit 5 **(Lectures 10)**

Inflammation in normal and pathological state. Molecular mechanisms driving the immunopathology in cancer, neurodegenerative diseases, autoimmune diseases and diabetes. Interdependence of molecular pathways in controlling homeostasis and disease pathology.

Unit 6 **(Lectures 7)**

How the molecular changes can be targeted to reverse the pathology and the contribution of drugs in this respect cancer, neurodegenerative diseases, autoimmune diseases and diabetes.

Unit 7 **(Lectures 6)**

DNA modifications and mutations in diseases and its significance in the pathology associated with cancer, neurodegenerative diseases, autoimmune diseases and diabetes. Role of environment in (lifestyle) in modifying DNA and the molecular landscape associated with homeostasis and disease in cancer, neurodegenerative diseases, autoimmune diseases and diabetes.

TEXT BOOK

Robbins Basic Pathology, 9th edition, Kumar, Abbas, Fausto and Mitchell; Saunders, Publication, ISBN-13: 978-1437717815.]
Selected research articles will be provided before each class

Course Outcome

CO1: To demonstrate ability to approach a scientific report in a systematic manner
CO2: To be able to identify scientific hypothesis and understand the rationale behind the research approach in a scientific report
CO3: Be able to summarize disease pathogenesis and connect it to clinical signs and symptoms associated with the disease
CO4: Be able to work with team and put together in depth information related to disease mechanism at the cellular and molecular level, treatment options and current developments in the field
CO5: Be able to give a presentation related to molecular basis of a disease and field audience questions related to the topic

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	-	-	-	-	-	3	3	-	3
CO2	1	3	1	-	-	2	-	3	3	3	-	3
CO3	3	2	1	3	-	-	-	-	3	3	-	3
CO4	2	3	3	2	3	3	-	2	3	3	1	3
CO5	1	1	3	2	1	2	-	-	3	3	-	3

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**-**	**-**	**2**	**2**	**2**	**1**	**-**	**2**	**-**	**-**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**-**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**-**
CO5	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**-**	**-**

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM645 CANCER BIOLOGY 3-0-0-3

Course code:
Course name: CANCER BIOLOGY
Credits: 3
Pre-requisites: Undergraduate level basic biology, chemistry and medical science
Total number of classes: 45
Syllabus

Unit-1 **Lectures 8**

Introduction: Introduction to carcinogenesis; Clonal origins of cancer, Experimental biology, Clinical data, Linking laboratory and clinic; Defining a neoplasm: Classifying cancers.

Unit-2 **Lectures 8**

Epidemiology: Descriptive epidemiology, Analytical epidemiology, Criteria required to establish causality, Biomarkers, Molecular epidemiology, Factors that influence human carcinogenesis; Chemical and radiation carcinogenesis: Chemical carcinogenesis, Radiation carcinogenesis.

Unit-3 **Lectures 8**

Growth: Cancer cells, Senescence, Cell mortality and telomerase, Apoptosis and cancer; Responding to the environment: General features, How a cell interacts with its environment, Hydrophobic growth regulatory molecules, Cross-talk between signaling pathways.

Unit-4 **Lectures 8**

Invasion and metastasis: Escape from local control and invasion, Intravasation, Transport in the bloodstream, Extravasation, Angiogenesis, Gene changes involved in metastasis.

Unit-5 **Lectures 8**

Crowd Control: Mechanisms of immune response to cancer, Tumour microenvironment, Pro- and anti-tumour activities in tumour microenvironment, How tumor cells evade from immune responses.

Unit-6 **Lectures 5**

Principles of cancer treatment: Principles behind the treatment of cancer, New forms of treatment; Approaches to cancer prevention.

Course Outcome

CO1 To understand carcinogenesis, clinical connection and classification of cancers based on cellular origin

CO2 To understand the epidemiology of cancer including biomarkers and chemical and radiation-related origins of cancer

CO3 To learn about the connection between cell division, cell differentiation and apoptosis, and cancer.

CO4 To understand invasion of cancer cells and colonization at other sites in the body

CO5 To learn about tumour immunology, immune evasion of cancer cells and new forms of cancer therapy

TEXT BOOKS:

1. Ruddon RW: Cancer Biology, 4th Edition, Oxford University Press, 2007.
2. King RJB, Robins MW: “Cancer Biology”, Third Edition, Pearson Education Ltd, 2000.

REFERENCE

1. Robin Hesketh. Introduction to Cancer Biology, Cambridge University Press, 2012.
2. Weinberg, Robert A. The Biology of Cancer, Second Edition. New York: Garland Science, 2013.

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

0 – No affinity; 1 – low affinity; 2 – Medium affinity; 3 – High affinity

c / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	2	2	3	0	0	0	0	3
CO 2	3	2	2	2	2	3	3	0	0	0	0	3
CO 3	3	2	2	2	3	3	3	0	0	0	0	3
CO 4	3	1	1	2	3	3	3	0	0	0	0	3
CO 5	3	3	3	3	2	3	3	0	0	0	0	3

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

C / C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10

CO 1	3	1	3	2	1	0	0	0	0	1
CO 2	3	1	3	3	3	0	0	3	0	3
CO 3	3	3	3	3	2	0	0	2	0	3
CO 4	3	2	3	3	1	0	0	2	3	0
CO 5	3	2	2	3	0	0	0	0	0	3

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

THIRD SEMESTER

24MM798 Dissertation-I Credit 14

Initiation of research on a selected research topic under the guidance of a faculty, with meticulous experimentation for the generation of data. Manuscript writing on the research work conducted thus far, for a possible publication by the end of the final semester. Mid-thesis presentation to judge the progress of the research work done.

24MM701 STATISTICAL DATA ANALYSIS 1-0-1-2

Pre-requisites: Undergraduate level statistics and biology
Total number of classes: 30
Syllabus

Unit 1 Lectures 6

Introduction to Biostatistics-Need for Biostatistical Methods –Their uses and Misuses, Types of Variables, Data collection Methods, Population and Sample.
Descriptive Data Analysis Methods- Statistical Tables, Diagrams examples; Graphs, Measures of Central Tendencies and Dispersion, Correlation Analysis Methods, Linear Regression Analysis.

Unit 2 Lectures 6

Theory of probability, Standard Probability Distributions – Discrete distributions Binomial and Poisson;, Univariate continuous distribution – Normal, and standard normal.

Unit 3 Lectures 6

Tests of Significance of Statistical Hypotheses- Concept of Hypotheses –Null and Alternative hypotheses, Type I and Type II errors, Significance level, Critical region, Power of a test , P- value and its interpretation; Large and Small Sample Test – Normal test, Student's 't' test, Chi-square tests, Analysis of variance.

Unit 4 **Lectures 6**

Nonparametric methods-Non-parametric methods for estimation, Methods for tests of significance for the independent and correlated samples, Nonparametric Methods for more than two populations..

.**TEXT BOOKS**

1. Statistical Techniques for data Analysis: J.K. Taylor & Cheryl C, 2004 Chapman & Hall (CRC).

2. Performing Data Analysis Using IBM SPSS: Lawrence S Meyers, 2015, John Wiley..

REFERENCE

Biostatistics: A Foundation for Analysis in the Health Sciences: Daniel, Wayne W 8thEd. 2005.

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM781 CELL CULTURE AND ANIMAL LAB 1-0-1-2

Pre-requisites: Basic understanding of biology

Total number of lab sessions: 30

Preamble: Cell culture module introduces the students to the basics of cell culture. The course provides students with sufficient knowledge and laboratory skills needed in academia and industry for carrying out basic cell culture techniques properly and safely to perform independently the cell culture technique. The animal handling module introduces students to the regulations, ethics and importance of animal use in research, particularly how the animal use is justified along with basic small animal handling techniques

Syllabus

Unit 1 **(Lab sessions = 3)**

General lay out of a cell culture lab, physical environment needed for the cell culture, growth media and its composition, particularly how the animal use is justified (BSC) and its use in cell culture and how to work in a BSC, organization of cell culture reagents and materials inside the hood to minimize contamination during cell culture and how to control it, culturing and splitting of cell lines, cryopreservation of cells and cell viability assays.

Unit 2 **(Lab sessions = 7)**

Hands-on cell culture work, media changes, seeding, splitting adherent cells, cell counting, reseeding, and safe disposal

Unit 3 **(Lab sessions = 5)**

Animal handling techniques, animal feed, gavage, different routes of injection, ethical treatment of animals and Institutional Animal Ethics Committee policies

REFERENCE:

1. *R. Ian Freshney. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th ed. 2010. Wiley-Blackwell.*

2. *CPCSEA Guidelines for Laboratory Animal Facility, 2004.*
   Guide for the Care and use of Laboratory Animals – 8th Edition, 2011, The National Academic Press.

Course Outcome

CO1: To demonstrate a general level of understanding towards the function, maintenance and working of Bio-safety Cabinets (BSC) and be able to work in BSCs with a good sterilization technique
CO2: To identify culture contamination and methods involved to maintain sterility
CO3: Able to prepare media and maintain adherent cells in culture for atleast a week
CO4: To become aware of standard practices in cell culture and related ethical dilemmas
CO5: Be able to handle small animals and become familiar with ethics involved in animal use for research.

Programme Outcomes (PO) (As given by NBA and ABET)

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	3	-	3	-	1	1	-	2
CO2	2	3	-	-	-	-	3	-	1	1	-	2
CO3	2	3	-	3	3	-	3	-	3	1	-	2
CO4	2	1	-	-	-	3	3	3	3	2	-	2
CO5	2	1	-	-	2	3	3	3	3	2	-	2

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function

PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular dysregulation in diseases
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cell based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	1	-	-	3	-	-	-	1	-
CO2	-	-	-	-	3	-	-	-	1	-
CO3	-	-	-	-	3	-	-	-	2	-
CO4	-	-	-	-	3	-	-	-	1	-
CO5	-	-	-	-	3	-	-	-	2	-

Evaluation Pattern: 30+70 = 100

Internal Assessment – 30%		
Records	Evaluation	30%
		30%
End Semester Examination- 50%		
Practical	Exam	60%
Assessment	Viva	10%
		70%
	Total	**100%**

24MM702 ETHICS IN RESEARCH AND RESEARCH METHODOLOGY 1-0-1-2

Course code:
Course name: ETHICS IN RESEARCH AND RESEARCH METHODOLOGY
Credits: 2
Pre-requisites: Basic level biology
Total number of classes: 30

Syllabus

Unit 1 **Lectures 15**

Plagiarism, regulatory principles, safety in research, ethics in stem cell research, ethics in clinical research, ethics in nanomaterials based research, Case studies

Unit 2 **Lectures 15**

Principles of data documentation, protocol development, research questions and hypothesis driven research.

Course Outcome:

CO1 Understand the basic concepts of ethics in proper conduct of research
CO2 Understand about plagiarism in research and how it should be avoided

CO3 Gain a clear idea about the importance of proper data documentation
CO4 Students will have a clear idea about the research methodologies that need to be adopted during their research

TEXTBOOKS:

1. Research Ethics for Scientists, C. Neal Stewart Jr., Wiley-Backwell Publishers, 2011
2. Ethics in Science, Ethical Misconduct in Scientific Research, John D'Angelo, CRC Press, 2012.

ELECTIVES

24MM731 ORGANOIDS AND ORGANS-ON-CHIPS 2-0-0-2

Pre-requisites: Undergraduate level basic biology, biotechnology and medical science
Total number of classes: 30

Preamble
The objective of this course is to familiarize students with the state-of-the art in vitro model systems that have the potential to mimic the normal and diseased human tissues and organs for biomedical research and development.

Syllabus

Unit -1 (6 Lectures)
In vitro model systems in medicine; basic concepts in developing in vitro models, biofabrication strategies for developing in vitro models, impact of in vitro models in disease modeling and drug testing, basics in 3D cell culture

Unit-2 (6 Lectures)
Microfluidic cell culture systems; Introduction to microfluidic systems, the design concept
and key components, fundamentals of organs-on-chips as in vitro microphysiological systems, applications of organs-on-chips in disease modelling, and safety and efficacy testing

Unit-3 (6 Lectures)
Organoids; Basics of organoid development, experimental strategies, essential reagents and choice of 3D matrices, characterization of organoids, technical challenges.

Unit-4 (6 Lectures)
3D Bioprinting in organoid development; Basics and importance of 3D printing of living cells for medical applications, choice of bio-inks, current advances and challenges in 3D bioprinting.

Unit-5 (6 Lectures)
Organoids as in vitro model systems; cerebral organoids, liver organoids, intestinal organoids, pancreas and salivary gland organoids. Applications of organoids in cancer research, drug development and testing

TEXT BOOKS:

1. *Microfluidics: Fundamentals, Devices, and Applications, Wiley, 2018*

2. *Organ-on-a-chip, Engineered Microenvironments for Safety and Efficacy Testing, Academic Press, 2018*
3. *Jamie Davies and Melanie Lawrence, Organoids and Mini Organs, Academic Press, 2018*

Course Outcome

CO1 Understanding on the different types of in vitro model systems and their advantages over conventional 2D cell culture systems

CO2 Understanding on the basic principles and components of microfluidics-based in vitro model systems

CO3 Understanding on the basic principles and components of organs-on-chips based in vitro model systems

CO4 Understanding on organoid development procedure, organoid types, advantages and challenges

CO5 Understanding on the working principle and components of 3D bioprinting and its applications

CO6 Understanding on the latest approaches and protocols used for developing various types of organoids for modeling diseases and drug testing.

Program Outcome

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

3 = High Affinity, 2 = Medium Affinity, 1 = Low Affinity, - No Affinity

Program Specific Outcomes. (PSO)

PSO 1 - Biochemical organization and cellular complexity in function

C / C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	3	1	2	-	-		-	-	-	2
CO 2	-	1	3	1	2	-	-		-	-	-	2
CO 3	-	1	3	1	2	-	-	-	-	-	-	2
CO 4	3	1	3	1	2	2	-	2	-	-	-	2
CO5	1	1	3	1	2	-	-	-	-	1	-	2
CO6	2	1	3	1	2	2	-	1	-	1	-	2

PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease

PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

C C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	-	1	-	-	3	-	-	2	-	-
CO 2	-	-	-	-	3	-	-	2	-	-
CO 3	-	-	-	-	3	-	-	2	-	-
CO 4	2	2	-	2	3	-	1	3	3	-
CO5	-	-	-	-	3	-	1	3	-	-
CO6	2	2	3	2	3	-	1	3	3	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		
Theory Exam	50%	
		50%
	Total	**100%**

24MM732 MOLECULAR DIAGNOSTICS 2-0-0-2

Pre-requisites: Basic understanding of biology and biotechnology
Total number of classes: 30
Preamble
This course will provide an overview of the principles of molecular diagnostics, the use of various molecular techniques to diagnose disease, quality assurance in the molecular lab and DNA based identity testing.

Syllabus

Unit 1 (Lectures 6)
Introduction: An Historical Perspective on the Clinical Diagnostic Laboratory.Molecular

Techniques for diagnosis – Methods for extracting nucleic acids (DNA & RNA); Methods for Nucleic Acid Amplification: PCR, Modifications of PCR (Multiplex-PCR, SSP-PCR, Nested PCR, Reverse transcriptase PCR [RT-PCR], Realtime PCR)

Unit 2 **(Lectures 6)**

Methods for mutation detection: PCR-RFLP, DNA Sequencing, Reverse Hybridization Assay, Multiplex ligation-dependent probe amplification [MLPA], Allele specific PCR; NGS Applications, Global review of NGS platforms, Clinical NGS in practice. Other Clinical Diagnostic Technologies: Flow Cytometry, Fluorescence In Situ Hybridization, Immunohistochemistry, Laser Capture Microdissection (FFPE).

Unit 3 **(Lectures 6)**

Quality Assurance in the Molecular Diagnostics Laboratory: Framework for Quality Assurance in Molecular Diagnostics, Verification of Molecular Assays, Standards and Standardization of Molecular Diagnostics, Laboratory-Developed Tests in Molecular Diagnostics.

Unit 4 **(Lectures 7)**

Applications of Molecular Diagnostics for Genetic Diseases, Molecular diagnostics of Coagulation, Cystic Fibrosis; Prenatal Genotyping for Identification of Fetuses at Risk for Immune CytopenicDisorders. Applications of Molecular Diagnostics for Human Cancers. Applications of Molecular Diagnostics for Infectious Diseases, Identity-Based Testing: HLA Typing Using Molecular Methods. Molecular Analysis for Forensic Casework and Parentage Testing, Molecular Assessment of Bone Marrow Transplant Engraftment. Personalized Medicine.

Unit 5 **(Lectures 5)**

Genetic Counseling Considerations in Molecular Diagnosis, Ethical, Social, and Legal Issues Related to Molecular Genetic Testing.

TEXT BOOKS

Molecular Diagnostics: For the Clinical Laboratorian. William B. Coleman (Editor), Gregory J. Tsongalis (Editor) Publisher: Springer-Verlag New York, LLC.

REFERENCES:

Buckingham and Flaw's, "Molecular Diagnostics: Fundamentals, Methods and Clinical Applications", F.A. Davis Company; First edition, 2007.

Course Outcome

CO1 Understand the molecular diagnostic aspects, its significance and goal
CO2 Understand the technology behind the various molecular techniques used in the clinical diagnostic laboratory for the diagnosis of various pathogenic situations
CO3 Develop awareness of sample types, preparation, and storage for molecular diagnostic tests.
CO4 Understand the Quality assurance that needs to be followed in the molecular diagnostic lab
CO5 Develop awareness of ethical issues related to genetic testing

PO1: Bioscience Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions
PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Bioscientist and Society

PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

c C O	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	-	2	-	-	-	-	-	-	2
CO 2	3	2	2	2	3	-	-	-	-	-	-	1
CO 3	3	2	2	2	3	-	-	-	-	-	-	1
CO 4	3	2	1	1	2	-	-	-	-	-	-	1
CO 5	1	-	-	-	-	2	-	3	-	-	-	1

Program Specific Outcomes. (PSO)
PSO 1 - Biochemical organization and cellular complexity in function
PSO 2 - Biomolecules in Medicine
PSO 3 - Molecular basis of disease
PSO 4 - Molecular technology in diagnosis and therapy
PSO 5 - Cellular based approaches in diagnosis and therapy
PSO 6 - Microorganisms in Medicine
PSO 7 - Nanoscale entities and its significance in Medicine
PSO 8 - Tissue architecture engineering in Medicine
PSO 9 - Compounds as drugs and its efficacy
PSO 10 - Bioinformatics and biological data use

- C O	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO 1	-	2	1	3	1	2	-	-	-	1
CO 2	-	1	1	3	-	_	-	-	-	3
CO 3	-	2	1	3	2	1	-	-	-	-
CO 4	-	-	-	3	-	-	-	-	-	-
CO 5	-	1	1	1	-	-	-	-	-	-

Evaluation Pattern: 50+50 = 100

Internal Assessment – 50%		
Periodical 1	Exam	20%
Periodical 2	Exam	20%
Continuous Assessment	Assignment/Test/Quiz	10%
		50%
End Semester Examination- 50%		

Theory Exam	50%	
		50%
	Total	**100%**

FOURTH SEMESTER

24MM799 **DISSERTATION-II** **Credit 17**

Full-time research on the proposed research, meticulous experimentation, generation of data, interpretation of data and conclusion of the research outcome. Manuscript writing on the research work conducted for publication, followed by manuscript submission by the end of the semester. Dissertation preparation and presentations.

23HU611	**Career Competency II**	**L-T-P-C: 0-0-3-1**

Pre-requisite: Willingness to learn, team spirit, basic English language and communication skills and knowledge of high school level arithmetic.

Course Objectives:

- Help students to understand the importance of interpersonal skills and team work
- Prepare the students for effective group discussions and interviews participation.
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively by using the correct diction, grammar and verbal reasoning skills

Course Outcomes:

CO1: Soft Skills - To demonstrate good interpersonal skills, solve problems and effectively participate in group discussions.
CO2: Soft Skills - To write technical resume and perform effectively in interviews.
CO3: Aptitude - To identify, investigate and arrive at appropriate strategies to solve questions on arithmetic by managing time effectively.
CO4: Aptitude - To investigate, understand and use appropriate techniques to solve questions on logical reasoning and data analysis by managing time effectively.
C05: Verbal - To be able to use diction that is more refined and appropriate and to be competent in knowledge of grammar to correct/improve sentences
C06: Verbal - To be able to examine, interpret and investigate passages and to be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

CO-PO Mapping

PO / CO	PO1	PO2	PO3
CO1	2	1	-
CO2	2	1	-
CO3	2	1	-
CO4	2	1	-

CO5	1	2	-
CO6	2	2	-

Syllabus

Soft Skills

Interpersonal skill: ability to manage conflict, flexibility, empathetic listening, assertiveness, stress management, problem solving, understanding one's own interpersonal needs, role of effective team work in organizations

Group problem solving: the process, the challenges, the skills and knowledge required for the same.

Conflict management: the concept, its impact and importance in personal and professional lives, (activity to identify personal style of conflict management, developing insights that helps in future conflict management situations.)

Team building and working effectively in teams: the concept of groups (teams), different stages of group formation, process of team building, group dynamics, characteristics of effective team, role of leadership in team effectiveness. (Exercise to demonstrate the process of emergence of leadership in a group, debrief and reflection), group discussions.

Interview skills: what is the purpose of a job interview, types of job interviews, how to prepare for an interview, dos and don'ts of interview, One on one mock interview sessions with each student

Verbal

Vocabulary: Help students understand the usage of words in different contexts. Stress the importance of using refined language through idioms and phrasal verbs.

Grammar: Enable students to identify poorly constructed sentences or incorrect sentences and improvise or correct them.

Reasoning: Facilitate the student to tap her/his reasoning skills through critical reasoning questions and logical ordering of sentences.

Reading Comprehension: Enlighten students on the different strategies involved in tackling reading comprehension questions.

Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.

Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

Aptitude

Sequence and Series: Basics, AP, GP, HP, and Special Series.

Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.

Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.

Probability: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes' Theorem.

Logical Reasoning I: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives, Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

Logical Reasoning II: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding & Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management Strategies.

References
Soft Skills

Team Building

- Thomas L.Quick, "Successful team building", AMACOM Div American Mgmt Assn, 1992
- Brian Cole Miller, "Quick Team-Building Activities for Busy Managers: 50 Exercises That Get Results in Just 15 Minutes", AMACOM; 1 edition, 2003.
- Patrick Lencioni, "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 1st Edition, 2002

Verbal

- "GMAT Official Guide" by the Graduate Management Admission Council, 2019
- Arun Sharma, "How to Prepare for Verbal Ability And Reading Comprehension For CAT"
- Joern Meissner, "Turbocharge Your GMAT Sentence Correction Study Guide", 2012
- Kaplan, "Kaplan GMAT 2012 & 13"
- Kaplan, "New GMAT Premier", Kaplan Publishing, U.K., 2013
- Manhattan Prep, "Critical Reasoning 6th Edition GMAT"
- Manhattan Prep, "Sentence Correction 6th Edition GMAT"
- Mike Barrett "SAT Prep Black Book The Most Effective SAT Strategies Ever Published"
- Mike Bryon, "Verbal Reasoning Test Workbook Unbeatable Practice for Verbal Ability, English Usage and Interpretation and Judgement Tests"
- www.bristol.ac.uk/arts/skills/grammar/grammar_tutorial/page_55.htm
- www.campusgate.co.in

Aptitude

- Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT Common Admission Test", Tata Mc Graw Hills, 5th Edition, 2012
- Arun Sharma, "How to Prepare for Logical Reasoning for the CAT Common Admission Test", Tata Mc Graw Hills, 2nd Edition , 2014
- Arun Sharma, "How to Prepare for Data Interpretation for the CAT Common Admission Test", Tata Mc Graw Hills, 3nd Edition , 2015
- R.S. Aggarwal, "Quantitative Aptitude For Competitive Examinations", S. Chand Publishing , 2015
- R.S. Aggarwal, "A Modern Approach To Verbal & Non-Verbal Reasoning", S. Chand Publishing , Revised -2015
- Sarvesh Verma, "Quantitative Aptitude-Quantum CAT" , Arihant Publications , 2016
- www.mbatious.com
- www.campusgate.co.in
- www.careerbless.com

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**