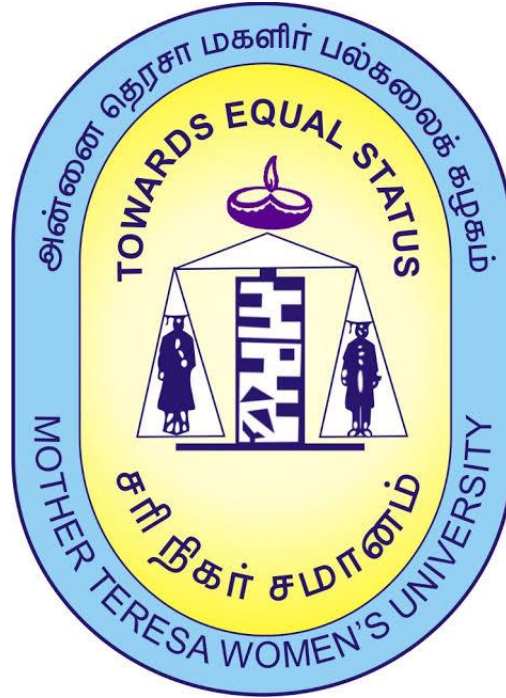


MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL - 624 101
Tamil Nadu.



Curriculum Framework and Syllabus for

M.Phil. ZOOLOGY

(For the candidates to be admitted from the academic year 2021-2022 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

**MOTHER TERESA WOMEN'S UNIVERSITY
KODAIKANAL**

Name of M.Phil Programme : M.Phil. – Zoology

Eligibility : Masters degree in Zoology discipline with 55% marks
Common Entrance Exam : University conduct a Common Entrance Test (CET) for M.Phil admission

M.Phil. Zoology – SYLLABUS Framework- 2021-2022 onwards

No	Paper Code	Course Title	Hours	Credits	Continuous Internal Assessment (CIS)	End Semester Exam (ESE)	Total
Semester I							
1.	M21ZOT11	Core I (Theory)- Research Methodology	10	4	40	60	100
2.	M21ZOT12	Core II (Theory)	10	4	40	60	100
3.	M21PST13	Core III (Theory)- Common Paper Professional Skills	10	4	40	60	100
		Total	30	12			300
Semester II							
4.	M21ZOT21	Core IV (Theory)- Special Paper	10	4	40	60	100
5.	M21ZOD22	Dissertation + Viva- voce	20	14 (12+2)	-	-	200
		Total	30	18			300
Total			60	30			600

Special Papers related to Project:

Sl.No.	Course
1.	Special paper I-Animal Biotechnology
2.	Special Paper II- Stem Cell Biology
3.	Special Paper III- Nanotechnology and Cancer Biology
4.	Special Paper IV- Pharmaceutical Biotechnology
5.	Special Paper V- Drug Metabolism
6.	Directed Study [#]
7.	Any UGC approved online course related to research (equal credit)

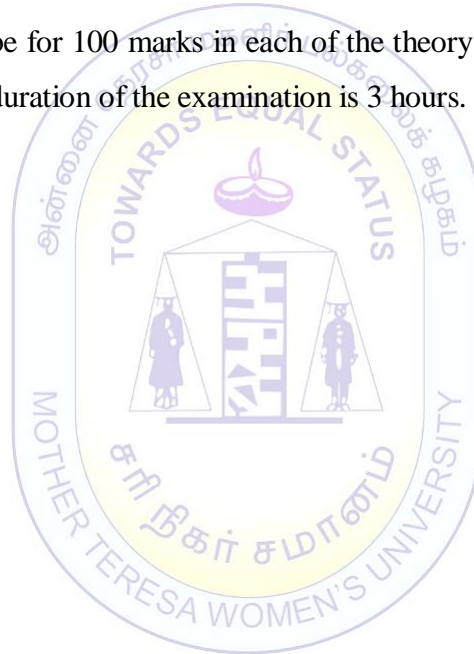
[#] Any new course can be added as special paper by getting permission from BoS and Academic council.

The M.Phil course consists of four theory papers. Paper III is common for all the programmes. Special Paper (IV) is pertaining to the area of specialization chosen by the candidate with the approval of guide.

Each candidate will submit a dissertation on a topic in the relevant discipline after carrying out the project work under the supervision of a guide. The duration of the project work will be for six months.

The dissertation will be evaluated by an external examiner and viva voce will be conducted for the candidate.

The examination will be for 100 marks in each of the theory papers. The question paper will cover the entire syllabus. The duration of the examination is 3 hours.



PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

On completion of this program, students will be able

PEO 1: To equip the students to be competent in the field of Animal science and its related areas

PEO 2 : To instill the potential of practical skill, academic skills, to work as entrepreneurs, techno-managers and researchers with strong ethics and communication skills

PEO 3: To encourage the students to pursue research in reputed institutes at national and international level

PEO 4: To cultivate working knowledge in students to develop animal products, processes and designs for society

PEO 5: To encourage the students to work as research associates under government funded projects to contribute scientifically to the society

PROGRAMME OUTCOME (PO)

On completion of M.Phil Zoology, graduates will be able to

PO1: apply the scientific knowledge to provide solutions to lead a healthy life

PO2: acquire basic knowledge of research such as data collection, processing and presentation of data and also learn the application of various research tools

PO3: write research articles, review articles, chapters and books for further publicize

PO4: apply their skills and techniques to improve quality of animal products

PO5: design and carry out a research project.

PO6: understood the handling of Good laboratory practices.

PO7: describe the Principles and Applications of Tracer Techniques in Biology.

PO8: acquire first-hand experience in working on projects at individual and knowledge on various research institutes

PROGRAMME SPECIFIC OUTCOME (PSO)

On completion of M. Phil. Zoology program,

1. Students will be able to solve the problems of society by apply the scientific knowledge
2. Students will be able to reach a high level of achievement in writing, research or project activities and communications
3. Students will be able to critical and creative thinkers, with an aptitude for continued self-directed learning are able to examine critically, synthesize and evaluate knowledge across a broad range of modern Zoology.
4. Students will be able to proficiency to communicate research findings at diverse levels
5. Students will be able to design and execute experiments related any field of Modern Zoology for sustainable development



Course Title & Code	CORE I - RESEARCH METHODOLOGY - M21BOT11		
Semester	Semester-I	Credits:4	Hours/weeks: 10
Cognitive Level	K1: Recall K2:Understand K3:Apply K4:Evaluate		
Learning Objective	<ul style="list-style-type: none"> To gain familiarity with research and its types. To learn the appropriate methods of literature collection and analysis To understand data validation and interpretation To apply suitable statistical analysis and tools in research. To inculcate interest in students to pursue research. 		
Course Outcomes	At the end of the course, the student will be able to		
	CO1	know types of research and its importance, research ethics, research proposal writing	K1,K2
	CO2	apply the Statistics in Research using different statistical tools	K3
	CO3	understand the principles and procedures of bioinstruments for analysis of biomolecules	K2,K3
	CO4	understand the different types of PCRElectrophoresis:	K3
	CO5	evaluate the Database similarity searching tools for nucleic acid and proteins	K4
Unit I	Research : Types of research, Role of literature review in research, Importance of formulating a research problem. Collection and displaying of data. Writing a research report. Importance and need for research ethics and scientific research. Writing Thesis, publication, Writing article, Plagiarism, Research Proposal writing.		
Unit II	Statistics in Research: Measures of central tendency: arithmetic mean, median, mode, geometric mean, Harmonic mean. Measures of dispersion: range, interquartile range, standard deviation, variance. Simple linear regression and correlation. Analysis of variance. Hypothesis testing - Idea of two types of errors and level of significance. Tests of significance: Parametric (F & t test); Non parametric: Chisquare tests		
Unit III	Principle of biophysical method and used for analysis of biopolymer structure: UV visible, FTIR,XRD, SEM and TEM, TLC,HPTLC,HPLC, GC-MS, Atomic absorption and plasma emission spectroscopy, Nuclear Magnetic Resonance Spectroscopy. MALDI-TOF-TOF.		
Unit IV	Electrophoresis: Principle and applications of Native, SDS, and 2D- gel electrophoresis. Polymerase Chain reaction(PCR) - Principles and Types - Real-Time PCR (quantitative PCR or qPCR) Reverse-Transcriptase (RT-PCR),Multiplex PCR, Nested PCR, Hot Start PCR,GC-Rich PCR, Long-range PCR and Arbitrary Primed PCR. Applications of PCR.		

Unit V	Database similarity searching - BLAST – BLASTN and BLASTP, Gene sequence submission format - FASTA, multiple sequence alignment (CLUSTAL W), Phylogenetic analysis tools- Phylip, ClustalW, Online phylogenetic analysis. Visualisation of protein structure – (Ras Mol, Cn3d, SWISS – PDB viewer).
Text Books	<ol style="list-style-type: none"> 1. Akash Ved. Biostatistics & Research Methodology. Publisher Thaukur Publication, 2019. 2. Selzer, Paul M., Marhofer, Richard J., Koch, Oliver. An Introduction Applied Bioinformatics, Springer, 2018. 3. L. Veerakumari. Bioinstrumentation. MJP Publishers. 2011.
References	<ol style="list-style-type: none"> 1. Dubey Diwedi, Usman, Srivastava. Biostatistics and Research Methodology. Publisher S VikaS and Company, 2019 2. MJ Reily. Bioinstrumentation. CBS Publishers & Distributors, 2019. 3. <u>B Annadurai</u>. A Textbook of Biostatistics. Publisher New Age International Private Limited, 2017. 4. Selzer, Applied Bioinformatics: An Introduction, Publisher Springer, 2018. 5. Norman T.S. Bailey, Statistical Methods in Biology. Cambridge University Press, UK. . 2012
E-reference links:	<ol style="list-style-type: none"> 1. https://www.allassignmenthelp.com/blog/types-of-research/ 2. https://www.bioinformatics.org/ 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1122955/ 4. https://www.csulb.edu/~msaintg/ppa696/696stsig.htm 5. https://www.enago.com/academy/importance-of-research-ethics/

Mapping of COs with POs & PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	M	M	M	M	M
CO2	S	S	S	S	S	S	S	S	M	M	M	M	S
CO3	S	S	S	M	M	S	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S	S	S	S
CO5	S	S	S	M	M	S	S	S	S	S	S	S	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

Course Title & Code	CORE II-(THEORY)-RECENT ADVANCES IN ZOOLOGY- M21ZOT12		
Semester	Semester- I	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand	K3: Apply	K5:Analyse K6: Create
Learning Objective	<ul style="list-style-type: none"> To learn the advanced and modern techniques in Zoology To attain deep knowledge on cutting edge technologies for future research. To learn the principles and mechanisms behind the new trends in Animal Biotechnology. To gain knowledge on up-to-date technological advancements on the completion of the course. 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	comprehend the biomolecules chemistry	K2
	CO2	acquire knowledge on immune system	K2
	CO3	analyse the route of xenobiotics and biomagnifications process	K3
	CO4	analyse the transport across the cell membrane	K5
	CO5	practice cell culture and gene transfer methods for producing transgenic animals	K6
Unit I	Biomolecules: Structure – and metabolism of carbohydrates, polysaccharides, glycoproteins and peptidoglycans. structure of nucleic acids; conformation of proteins of polypeptides (secondary, tertiary, quaternary and domain structure) reserve turns and Ramachandran plot, structural polymorphism of DNA, RNA and three dimensional structure of tRNA. Central dogma of molecular biology, Regulation of gene expression in Prokaryotes and Eukaryotes; Operon Concept; Environmental regulation of gene expression. DNA methylation, DNA damage and repair, Oncogenes and cancer, Apoptosis.		
Unit II	Immunology: Antigen, Structure and functions of different classes of immunoglobulins and generation of immunological diversity; Humoral and cell – mediated immunity, primary and secondary immune response lymphocytes and accessory cells.; MHC, Complement fixation.		
Unit III	Pollution: Types of pollution –pollutants, xenobiotics, acute and chronic toxicity; Bioassay LC50 values of environmental pollution, impact on animals – Biomagnification – Detoxification mechanism; synergistic and antagonistic effects of pollutants – Biomagnifications and effects of pesticides.		
Unit IV	Membrane transport: Structure of membranes, Glycoconjugates and proteins in membrane systems; ion transport, Na/K ATPase; signal transduction in bacteria, plants and animals, model membranes; liposomes; principles and application of light, phase contrast, fluorescence, AFM, SEM, microscope fixation and staining.		

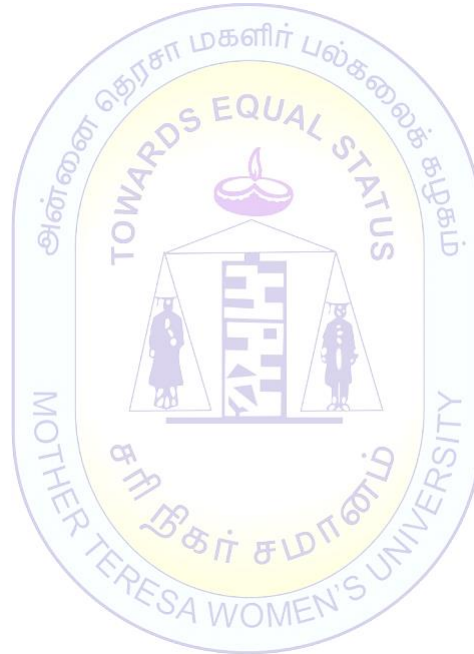
Unit V	Cell and tissue culture in animals; Gene transfer methods in animals; transgenic biology; hybridoma technology. Principles and techniques of nucleic acid hybridization and cot curves; sequencing of proteins and nucleic acids; southern, Northern and South – Western blotting techniques, polymerase chain reaction; methods for measuring nucleic acids.
Text Books	<ol style="list-style-type: none"> 1. N Robert Schlef, Genetics and Molecular biology, Second Edition 2. David Clark, Molecular biology- e book (2005), ISBN-9780123785909.
References	<ol style="list-style-type: none"> 1. Kuby J. <i>et al.</i>, Immunology, 6th Edition. W.H. Freeman and Company, New York. 2006. 2. Freshney. 2005. Culture of Animal Cells, 5th Edition, Wiley-Liss. 3. Ed. John R.W. Masters. 2000. Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press. 4. Ed. Martin Clynes. 1998. Animal Cell Culture Techniques., Springer. 5. Abbas, A.K., Lichtman, A.K., Pober, J.S. (1998). Cellular and Molecular Immunology. 3rd Edition, W.B.Saunders Company, U.S.A. 2. Benjamin Lewin (1999). Genes VII. Oxford University Press, New York. 6. Branden, C., Tooze, J. 1999. Introduction to protein structure. II Edition, Garland Publishing, Inc., New York. 4. Desmond, S.T., Nicholl. (1994). An introduction to genetic engineering Cambridge University Press, New York 7. HAWKINS, J.D. 1996. Gene structure and expression. III Edition. Cambridge University Press, New York.,2000, Enviro 8. Sharma.B.K., 2000. Environmental Chemistry . Fifth edition., Goel Publishing House, KRISHNA Prakashan Media (P) Ltd.Meerut. 9. Biotechnology.U. 2015. Biotechnology., Arunabha Sen, Books and Allied (P) Ltd,Kolkata-700009. 10. Nelson D.L and Cox M.M. 2006. Lehninger Principles of Biochemistry, 4th edition, Macmillan worth Publishers. 11. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P Walter, Garland Molecular Biology of the Cell (2014), 6th Edition, Publishing (Taylor Francis Group), New York & London (ISBN: 9780815344322).
E-References	<ol style="list-style-type: none"> 1. https://alraziuni.edu.ve/book1/Laboratories/microbiology%20immunology.pdf 2. https://nptel.ac.in/courses/102/106/102106084/

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	M	S	S	S	S	S	M	S
CO4	S	S	S	S	S	S	S	M	S	M	S	S	M
CO5	S	S	M	S	S	S	S	S	S	S	S	M	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) – 1 mark; No Correlation(N) – 0 mark



Course Title & Code	CORE III – Professional Skills- M21MBT13		
Semester	Semester- I	Credits:4	Hours/weeks: 10
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	<ul style="list-style-type: none"> Develop skills to ICT and apply them in teaching, learning contexts and research. Acquire the knowledge of communication skills with special reference to its elements, types, development and styles. Understand the terms: Communication technology, Computer Mediated Teaching and develop Multimedia/E-contents in their respective subjects. Develop different teaching skills for putting the content across to targeted audience. 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	Learn the computer basics and its application in science field.	K1
	CO2	Develop the communication skills in both English and tamil.c	K2
	CO3	Impart knowledge on computer mediated teaching.	K3
	CO4	Understand the basic concepts of micro teaching skills.	K2
CO5	Get familiar with basics of industrial technology	K2	
Unit I	Computer Application Skills: Fundamentals of Computers and windows, Operating System – MS – Office Components; Word: Equation editor, Table Manipulation – Formatting Features – organizational Chart. MS – EXCEL: Statistical Functions – Number Manipulation – Chart Preparation with various types of graphs. MS Powerpoint: Powerpoint presentation with multimedia features. Internet and its applications: E-mail and attachments – working with search engines.		
Unit II	Communication Skills (English/Tamil/Both): English: Skills of Communication: Listening, Speaking, reading and Writing – Writing Synopsis, Abstract and proposals. Developing good language abilities – Public speaking – Writing Skills. Tamil: gapw;Wtpf;Fk; jpwd; - Ngr;Rj;jpwd; - ntspg;ghl;Lj; jpwd; - Ma;Tj;jpl;lk; - Ma;Tr;R&f;fk; jahhpj;jy;.		
Unit III	Communication technology: Computer Mediated Teaching: Multimedia, E – Content, Satellite Based Communication – EDUSAT and ETV channels. Web: Internet I Education.		
Unit IV	Pedagogical Skills: Micro teaching Skills: Skill of Induction, Skill of Stimulus Variation. Skill of Explaining, Skill of Probing Questions, Skill of Blackboard, Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills – Research Extension and Consultancy.		
Unit V	Industrial Technology: Lecture Techniques: Steps, Planning of a lecture, Lecture Notes, Updating, Delivery of Lecture. Teaching – Learning Techniques: Team teaching, Group Discussion. Seminar, Workshops, Symposium and Panel Discussion – Games and Simulations – Web Based Instructions.		

Text Books	<ol style="list-style-type: none"> 1. Micael D. and William (2000). Integrating Technology into Teachnig and Learning: Concepts and Applications, Prentice Hasll, New York. 2. Information and Communication Technology in Education: A Curriuculum for Schools and Programme of Teacher development. Jonathan Anderson 3. Pandey S.K.(2005). Teaching communication. Commonwealth publisher, Delhi 4. Sharma. R.A.(2006), Fundamentals of education technology, Surya publication, Meerut
References	<ol style="list-style-type: none"> 1. Kum Babu A. and Dandapani S. (2006), Microteaching, Neelkamal Publications, Hyderabad 2. Vanaja M and Rajasekhar S. (2006), Computer Education, Neelkamal Publications, Hyderabad

Mapping of COs with POs &PSOs:

CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	M	S	M	S	S	S	S	S	S	S	S
CO2	S	S	S	S	M	S	S	S	S	M	S	S	S	S
CO3	S	S	S	M	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M	S	S	S	S

Strongly Correlating (S) - 3 marks
 Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark
 No Correlation (N) - 0 mark

Course Title & Code	CORE IV-SPECIAL PAPER I ANIMAL BIOTECHNOLOGY-M21ZOT21		
Semester	Semester- II	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand	K3: Apply	K5:Analyse K6: Create
Learning Objective	<ul style="list-style-type: none"> • To learn principles of plant and animal culture, media preparation. • To learn invitro fertilization and embryo transfer technology. • To learn molecular farming for commercially synthesizing products such as vaccines, hormones, proteins, enzymes, etc • To gain knowledge transgenic animals, cryopreservation, apoptosis, animal cloning, cell transformation, DNA microinjection and production of vaccines 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	set and analyse animal tissue culture lab	K3,K5
	CO2	prepare media and other requirements for cell culture	K3
	CO3	evaluate the different types of cell culture methods	K4
	CO4	perform cloning techniques	K3
CO5	produce transgenic animal	K6	
Unit I	Cell culture Laboratory design & Equipments: Planning, construction and services; Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO2 incubator; Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Water bath; Autoclaves and hot air oven; Pipette washers; Water purification system; Fluid handling systems and other equipments; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.		
Unit II	Cell culture Media and reagents: Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics, growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.		

Unit III	Different types of cell cultures: History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants.
Unit IV	Applications: Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for <i>in vitro</i> testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins
Unit V	Transgenesis and Stem cell biology: Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of proto-oncogenes; Stem cell markers; Methods of stem cell production in farm animals; Using stem cells for SCNT; Transgenesis and Xenotransplants.
Text Books	<ol style="list-style-type: none"> 1. Ed. Martin Clynes. 1998. Animal Cell Culture Techniques., Springer 2. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher – Jones and Barlett Inc. USA 3. Muñoz-López M, García-Pérez JL. DNA transposons: nature and applications in genomics. Curr Genomics. 2010;11(2):115-28.
References	<ol style="list-style-type: none"> 1. Freshney. 2005. Culture of Animal Cells, 5th Edition, Wiley-Liss. 2. Ed. John R.W. Masters. 2000. Animal Cell Culture – Practical Approach, 3rd Edition, Oxford University Press. 3. Ed. Martin Clynes. 1998. Animal Cell Culture Techniques., Springer. 4. B.Hafez, E.S.E Hafez, 2000.Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell. 5. Gordon, 1994. Laboratory Production of Cattle Embryos, 2nd Edition,

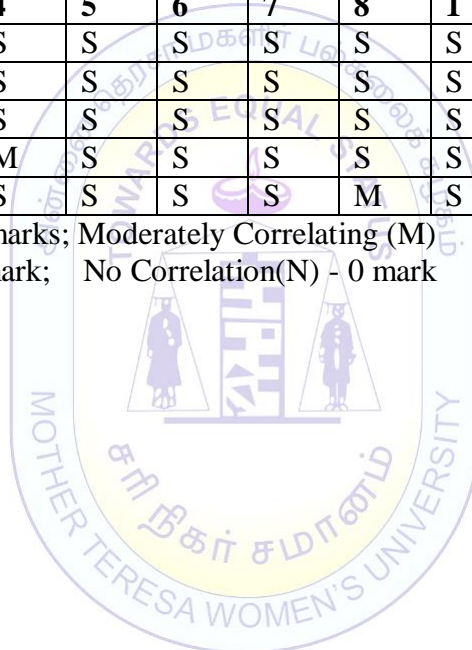
	CABI Publishing, CAB International, Wallingford, Oxon OX 10 8DE, U.K. 6. Louis-Marie Houdebine. 1997. Transgenic Animals: Generation and Use, 1 st Edition, CRC Press.
E-References	1. https://swayam.gov.in/nd1_noc20_bt31/preview 2. https://swayam.gov.in/nd1_noc19_bt33/preview 3. https://swayam.gov.in/nd1_noc19_bt15/preview 4. http://gurukpo./Content/Bsc-biotech/Animal%20Biotechnology%28B.pdf

Mapping of COs with POs & PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	M	S	S	S	S	S	S	S	M	S
CO5	S	S	M	S	S	S	S	M	S	M	S	M	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark



Course Title & Code	CORE IV-SPECIAL PAPER II STEM CELL BIOLOGY-M21ZOT21		
Semester	Semester- II	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand	K3: Apply	K5: Analyse
Learning Objective	<ul style="list-style-type: none"> To learn in vitro fertilization, therapeutic cloning, and genetic reprogramming. To learn distinguish between pluripotent and multipotent stem cells. To gain knowledge identifies potential applications for stem cell research. To learn risks associated with the use of stem cells for treating diseases 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	acquire knowledge on stem cells	K2
	CO2	analyse the pathways of stem cell proliferation	K5
	CO3	get knowledge about embryonic stem cells	K2
	CO4	perform organ regeneration	K3
CO5	apply stem cell therapy for wellbeing of human life	K3	
Unit I	Stem Cells: Introduction- Embryonic stem cells, Blastula, Inner cell mass, Totipotent, pluripotent, multipotent and Induced pluripotent stem cells characterization, potency, self-renewal, cell division, and differentiation		
Unit II	Development of stem cells: Pathways involved in stem cell proliferation, differentiation, and dedifferentiation - Signal transduction pathways and signaling molecules involved cellular proliferation, differentiation, and dedifferentiation. Relationship between cellular proliferation and differentiation concerning stem cells		
Unit III	Embryonic stem cells: How embryonic stem cells are obtained, in vitro multiplication: embryonic stem cells, gene manipulation and nuclear transfer technology. Adult stem cells - Methods to obtain stem cells from adults (Amniotic fluid, cord blood cells, Mesenchymal stem cells). Induced pluripotent technology (IPS), genes, and their mode of action in inducing stemness in adult cells. Advantages and disadvantages of IPS technology		
Unit IV	Organ regeneration: Organ regeneration using Stem cells - Heart regeneration, angiogenesis, kidney regeneration, a neurodegenerative disorder, spinal cord injury, tissue engineering. Ethics in using Embryonic stem cells - Human stem cell research: Ethical consideration; Stem cell religion consideration; Stem cell-based theories: Preclinical regulatory consideration, and Patient advocacy		
Unit V	Application of stem Cells: Overview of embryonic and adult stem cells for therapy in Neurodegenerative diseases; Parkinson's, Alzheimer's, Spinal Code		

	Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia.
Text Books	<ol style="list-style-type: none"> 1. Mary Clerke, jonathan Frampton (2020), Stem Cell biology and Applications, Published July 27, 2020 by Garland Science. 2. Mehmet Topcul, Idil cetin (2018) Stem Cells in Cell Therapy and Regenerative Medicine International OMICS eBooks. Publisher: Omics International E-Books ISBN: 9781-1-63278-021-8
References	<ol style="list-style-type: none"> 1. Cherian E (2011) Stem cells JP brothers medical publishers 2. Atala A (2012) Progenitor and Stem Cell Technologies and Therapies Woodhead publishing 3. Phinney DG (2011) Adult stem cells: Biology and methods of analysis Humana press 4. Ralf Pörtner. 2007. <u>Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology)</u>. 2nd Edition. Humana Press. USA. 5. R.Spier and J.Griffiths. 1994. Animal Cell Biotechnology. Academic Press. London. 6. D.C. Darling and S.J. Morgan. 1994. Animal Cells Culture and media, BIOS Scientific Publishers Limited. Oxford. UK. 7. Jennie P. Mather and David Barnes. 1998. Methods in Cell Biology. Volume 57: Animal Cell Culture Methods. Academic Press. New York. 8. Ann Harris. 1996. Epithelial Cell Culture, Cambridge University Press. USA.
E-References	<ol style="list-style-type: none"> 1. https://www.imedpub.com/stem-cell-biology-and-transplantation/ 2. https://www.jove.com/v/5331/an-introduction-to-stem-cell-biology

Mapping of COs with POs &PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	M	S	S	S	S	M
CO4	S	S	S	S	S	S	M	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S	S	M	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

Course Title & Code	CORE IV-SPECIAL PAPER III NANOTECHNOLOGY AND CANCER BIOLOGY- M21ZOT21		
Semester	Semester- II	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand K3: Apply K4: Evaluate K6: Create		
Learning Objective	<ul style="list-style-type: none"> To gain knowledge of the nanoscience and related fields. To learn the nanoscience and Applications. To learn the principles of cancer biology and identify the main cellular and molecular mechanisms. To learn proliferation control and signal transduction in malignant cells and normal cells. To learn molecular pathways responsible for genome instability in cancer cells and the multi-step process of tumor 2 progression leading to invasive metastatic growth 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	synthesis of nanoparticles and characterization	K6
	CO2	gain knowledge on application of nanotechnology	K2
	CO3	apply the nanoparticles for pollution control	K3
	CO4	comprehend the cancer biology	K2
CO5	compare and differentiate various tumour therapy	K4	
Unit I	Nanotechnology: definition – Quantum dots, Nanowires & properties, 2D films. Nano scale materials. Nano pores. Nanowires & properties, Nanoscience in Nano materials preparation silver, gold, iron and copper. Characterization – UV-Visible Spectrophotometer, X-RD, FTIR, SEM-EDAX,TEM		
Unit II	Application of nanotechnology; Nano sensors-types & its applications, Nano carriers for drug delivery-polymeric NP, Micelles, Micro emulsions, Lipoproteins as pharmaceutical carriers. Solid lipid NP as drug carriers. Nanocapsules-Preparation, Characterization & therapeutic applications. Nano medicine-Biopharmaceuticals. Implantable materials, Devices, Surgical aids, diagnostic tools, Genetic testing, Imaging.		
Unit III	Environmental Nanotechnology: Environmental nano remediation technology. Thermal, physico-chemical and Biological methods. Nano filtration for the treatment wastes, removal of organics, Inorganics and pathogens. Nanotechnology for water purification.		
Unit IV	Cancer: Epidemiology of cancer, cancer types, characteristics of cancer cells, carcinogenesis: Cancer initiation, promotion and progression, termination. Factors responsible for Carcinogenesis; Physical, Chemical and Biological.		
Unit V	Tumour therapy: Tumour immunology – tumour antigens, cytokines, vaccine development, immunotherapy and its limitations, Tumour cell evasions of immune defenses. Principles of chemotherapy and chemoprevention.		
Text Books	1. T.Pradeep, Texbook of Nanoscience & Nanotechnology, McGraw Hill Education (India) Private Limited.2012.		

	2. Michael A. Stroschio and Mitra Dutta. 2004. Biological Nanostructures and Applications of Nanostructures in Biology Electrical, Mechanical, and Optical Properties. Springer. USA.
References	<ol style="list-style-type: none"> 1. <u>K. Eric Drexler</u>, 1992. Nanosystems: Molecular Machinery, Manufacturing, and Computation. Wiley & Sons, Inc.: New York. 2. <u>Robert A. Freitas Jr.</u> Landes. 1999. Nanomedicine, Volume I: Basic Capabilities. Bioscience: Georgetown, TX. 3. <u>Robert A. Freitas Jr.</u> Landes, 2003. Nanomedicine, Volume IIA: Biocompatibility. Bioscience: Georgetown, TX. 2003. 4. Robert A. Freitas Jr. and Ralph C. Merkle. Landes, 2004. Molecular Assemblers and Nanofactories: Kinematic Self-Replicating Machines. Bioscience: Georgetown, TX.
E-References	<ol style="list-style-type: none"> 1. https://www.tandfonline.com/doi/full/10.1080/24701556.2020.1835978 2. https://www.tribonet.org/wiki/nanotribology/ 3. https://royalsocietypublishing.org/doi/10.1098/rsta.2007.2170 4. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/PH/PH709_Cancer/A10-Cancer.pdf 5. http://csbl.bmb.uga.edu/mirrors/JLU/DragonStar2017/download/introduction-to-cancer-biology.pdf

Mapping of COs with POs & PSOs:

CO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	S	M	S	M	M
CO5	S	S	S	S	S	S	S	M	S	S	S	M	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks
 Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark

Course Title & Code	CORE IV-SPECIAL PAPER IV PHARMACEUTICAL BIOTECHNOLOGY- M21ZOT21		
Semester	Semester- II	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand K5: Analyze		
Learning Objective	<ul style="list-style-type: none"> To learn about biopharmaceutical potential To learn mechanism of drug action, dose relationship and pharmacokinetics like absorption, distribution, metabolism and excretion (ADME) of drugs. Understand drug safety and effectiveness like factors affecting drug action and adverse drug reactions. 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	get knowledge on sources of biopharmaceuticals	K2
	CO2	analyse the routes of drug administration	K5
	CO3	acquire knowledge on chemical reaction and excretion of drugs	K2
	CO4	analyze the vaccine and its mode of action	K5
	CO5	understand the new drug discovery and approval procedures	K2
Unit I	Pharmaceutical Biotechnology: Sources of biopharmaceuticals - yeast, animal cell cultures, bacteria, fungi, plants, animals, transgenic plants. Drug isolation and evaluation. Formulation of biopharmaceutical products. Shelf life of protein based pharmaceuticals. Site specific delivery of protein drugs.		
Unit II	Routes of drug administration: Absorption of drugs. Bioavailability - factors influencing absorption and bioavailability. Drug distribution - plasma protein binding, placental transfer, blood-brain barrier. Mechanism of drug action, receptor theory, adverse effects of drugs, drug interactions.		
Unit III	Chemical reactions: (proteolysis, deamidation, oxidation, disulfide exchange), reduction, hydrogenation, dehydrogenation. Excretion Manufacturing principles - compressed tablets, controlled and sustained release dosage form enteric coated tablets and capsules.		
Unit IV	Vaccines: modern vaccine technologies, pharmaceutical aspects. Recombinant proteins as pharmaceutical drugs. Protein engineering, peptide chemistry and peptidomimetics. Catalytic antibodies. Monoclonal antibody based pharmaceuticals. Hematopoietic growth factors. Nucleic acid therapy in development. Pharmaceutical enzymes. Development of adhesion molecules. Glycoprotein and carbohydrate based pharmaceuticals (Elementary details only).		
Unit V	Drug Discovery: Strategies for new drug discovery, lead compound, combinatorial approaches to drug discovery, pre-clinical and clinical trials. Phase		

	I, II and III. Regulatory authorities - Food and Drug Administration (USA), European regulations- National security authorities, European medicine agency and new EU drug approval system.
Text Books	<ol style="list-style-type: none"> 1. Shargel L, Yu ABC, Wu-Pong S. Applied Biopharmaceuticals and Pharmacokinetics. McGraw-Hill. 6th ed. 2012. 2. Kayser O, Muller RH. Pharmaceutical Biotechnology- Drug Discovery and Clinical Applications. Wiley-VCH. 2004. 3. Walsh, Gary , Pharmaceutical biotechnology: concepts and applications,2007 4. Corina Jonescu, Drug metabolism current concept, Springer. 2018
References	<ol style="list-style-type: none"> 1. Gilman , Goodman and Gilman’s The Pharmacological Basis of Therapeutics. McGrawHill.12th ed. 2011. 2. Satoskar, Bhardarkar and Rege. Pharmacology and Pharmacotherapeutics. Poular Prakashan. 24th ed. 2015 3. Kayser O, Muller RH. Pharmaceutical Biotechnology- Drug Discovery and Clinical Applications. Wiley-VCH. 2004. 4. Klefenz H. Industrial Pharmaceutical Biotechnology. Wiley-VCH. 2002. 5. Shargel L, Yu ABC, Wu-Pong S. Applied Biopharmaceuticals and Pharmacokinetics. McGraw-Hill. 6th ed. 2012. 6. Spada S, Walsh G. Directory of Approved Biopharmaceuticals CRC Press. 2004
E-References	<ol style="list-style-type: none"> 1. https://benthamscience.com/journals/current-pharmaceutical-biotechnology/ 2. https://www.wiley.com/en-in/Pharmaceutical+Biotechnology%3A+Concepts+and+Applications-p-9780470012444

Mapping of COs with POs &PSOs:

CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	S	S	S	S	M	S	S
CO3	S	S	M	S	S	S	S	S	S	M	S	S	S	S
CO4	S	S	S	S	S	S	M	S	M	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S	S	S	S	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) – 1 mark; No Correlation(N) – 0 mark

Course Title & Code	CORE IV-SPECIAL PAPER V DRUG METABOLISM- M21ZOT21		
Semester	Semester- II	Credits:4	Hours/weeks: 10
Cognitive Level	K2: Understand K3: Apply K4:Evaluate K5:Analyse		
Learning Objective	<ul style="list-style-type: none"> To learn identify the fundamental principles of pharmacokinetics and pharmacodynamics. To learn pharmacodynamic and pharmacokinetic principles that describes drug actions in humans. Compare and contrast the specific pharmacology of the major classes of drugs, important distinctions among members of each class. To comprehend the toxic effect of drugs 		
Course Outcomes	Upon completion of this course the students will be able to		
	CO1	evaluate the drug administration and LD50	K4
	CO2	analyze the fate of drugs	K5
	CO3	evaluate the mode of action of antibiotics and drug resistance	K4
	CO4	acquire knowledge on metabolic disorder of drugs	K2
CO5	analyze the drugs toxicity	K5	
Unit I	General Pharmacology: Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50.		
Unit II	Pharmacokinetics: Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney		
Unit III	Therapeutics: Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. General principles of chemotherapy: chemotherapy of parasitic infections, fungal infections, viral diseases. Introduction to immunomodulators and chemotherapy of cancer.		
Unit IV	Screening for pharmacological activity: Analgesic, anti-inflammatory and antipyretic agents, gastrointestinal drugs, antiulcer and laxatives, antioxidants, anticancer and anti-fertility agents. Drugs for metabolic disorders like antidiabetic,		

	anti-hyperlipidemic, anti-obesity and hepatoprotective agents
Unit V	Clinical Toxicology: Definition, classification of toxicity – occupational, environmental and pharmaceutical. Types of toxins and their mechanism of action. Factors affecting toxicity- Drug tolerance, intolerance, addiction, allergy, hypersensitivity, antagonism and synergism. Methods of detection. Drug abuses and their biological effects. Rational prescription of drugs. Toxicity of anticancer drugs. Clinical symptoms of toxicity and marker parameters.
Text Books	<ol style="list-style-type: none"> 1. Michael D, Coleman, Human Drug Metabolism IIIrd Edition 2020 2. Ala F. Nassar Drug Metabolism Handbook: Concepts and Applications 2015 3. Padmaja Udaykumar, Textbook of pharmacology for Dental and Allied Health Science, Iind edition, Jaypee Brothers Medical Publishers (P) Ltd.2001
References	<ol style="list-style-type: none"> 1. G. Gordon Gibson and Paul Skett Introduction to Drug Metabolism, 2002 2. Ala F. Nassar, Drug Metabolism Handbook Concepts and Applications Wiley, 2005 3. F S K Barar, Essentials of Pharmacotherapeutics, S. Chand Limited, 2000. 4. Bertram Katzung, Anthony Trevor, Basic and Clinical Pharmacology, McGraw Hill Professional, 2014. 5. Golan, David E., Armen H. Tashjian, and Ehrin J. Armstrong, eds. Principles of pharmacology: the pathophysiologic basis of drug therapy. Lippincott Williams & Wilkins, 2011
E-References	<ol style="list-style-type: none"> 1. http://www.msmanuals.com/professional/clinical-pharmacology/pharmacokinetics/drug-metabolism 2. http://www.sigmaaldrich.com/technical-documents/articles/biofiles/phase-i-drug-metabolism.html 3. http://www.amjmed.com/article/S0002-9343(70)80129-2/abstract 4. https://www.basinc.com/assets/library/issues/19-1/19-1e.pdf

Mapping of COs with POs & PSOs:

CO	PO								PSO					
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	M	S	M	S	S
CO4	S	S	S	S	M	M	S	S	M	S	S	M	S	S
CO5	S	S	M	S	S	S	S	S	S	S	S	M	S	S

Strongly Correlating (S)- 3 marks; Moderately Correlating (M) - 2 marks

Weakly Correlating (W) - 1 mark; No Correlation(N) - 0 mark