K. K. UNIVERSITY

NALANDA, BIHAR, - 803115

SCHEME OF EXAMINATION
&
DETAILED SYLLABUS

For
Masters of Science
(Zoology)

2022-2023

Department of Zoology

School of Applied Sciences

BERAUTI, NEPURA, BIHARSHRIF,

Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

NALANDA

M.Sc. ZOOLOGY (Session 2022-2023)
Programme/Course Structure

Year	Semester	Course Code	Course Title	L	T	P	C
1	1	MSZG 1101	Invertebrate & vertebrate diversity and comparative anatomy	4	1	0	5
		MSZG 1102	Animal Physiology & Biochemistry	4	1	0	5
		MSZG 1103	Population Genetics, Animal systematics & Evolution	4	1	0	5
		MSZG 1104	Practical I (Based on MSZG 1101, 1102 & 1103)	0	0	2	1
			Total	**12**	**3**	**2**	**16**
	2	MSZG 1201	Developmental Biology and Endocrinology	4	1	0	5
		MSZG 1202	Environmental Biology and Ethology	4	1	0	5
		MSZG 1203	Histology, Histochemistry, Tool and Techniques	4	1	0	5
		MSZG 1204	Practical II (Based on MSZG 1201, 1202 & 1203)	0	0	2	1
			Total	**12**	**3**	**2**	**16**
2	3	MSZG 2101	Biostatistics and Bioinformatics	4	1	0	5
		MSZG 2102	Microbiology & Immunology	4	1	0	5
		MSZG 2103	Genetics & Cell Biology	4	1	0	5
		MSZG 2104	Practical III (Based on MSZG 2101, 2102 & 2103)	0	0	2	1
			Total	**12**	**3**	**2**	**16**
	4	MSZG 2201	Elective Theory I:	4	1	0	5
		MSZG 2202	Elective Theory II:	4	1	0	5
		MSZG 2203	Project /Dissertation	0	0	2	1
		MSZG 2204	Elective Practical	0	0	24	12
			Total	**8**	**2**	**26**	**23**

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SEMESTER: FIRST

MSZG 1101: Invertebrate & vertebrate diversity and comparative anatomy

UNITS	CONTENTS	Contact Hrs.
I	1. Colonial Protozoa and theories of origin of Metazoans. 2. Origin of coelom-Acoela, Pseudocoelom, Schizocoelom and Enterocoel 3. Adaptive diversity in Polychaeta. 4. Ancestral Mollusca and derivation of different classes of Mollusca	**06**
II	S. Dipleurula Larva and derivation of Deuterostome group 6. Locomotion: Cilia, Flagella- Protozoa 7. Foot in Mollusca and its adaptive value. 8. Excretion and Osmoregulation, Osmoregulation in Protozoa, Nephridia and coelomic system in annelids, Excretion in Arthropod.	**06**
III	9. Respiration Arthropods, Mollusca. 10. Larva: (theory of recapitulation and its evolutionary significance) Crustacean larva, Mollusca larva, larva of parasitic helminths & significances. 11. Concept of Host specificity and Host parasite relationship. 12. Fishes: Origin of Gnathostomes, Air breathing fishes, i. Electric organs & Electroreceptors in fishes	**06**
IV	13. Amphibians: a. Origin of Tetrapod's (early tetrapod, non-amniote Palaeozoic tetrapod) 14. Reptiles: i. Biology of sphenodon. ii. Factors responsible for extinction of Dinosaurs 15. Birds: 1.Aerodynamics and mechanism of flight 2.Convergence and Divergence of beak 3. Migration 16. Mammals: i. Dentition, ii. Adaptive Radiation in mammals	**12**
V	17. Development, general structure and functions of skin and its derivatives in Vertebrate series. 18. General plans of circulation in various group of Vertebrates Evolution of heart, Evolution of aortic arches. 19. Evolution of Urinogenital system in Vertebrates series. 20. Comparative anatomy of the brain in relation to its function, Autonomic nervous systems	**10**

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MSZG 1102: Animal Physiology & Biochemistry

UNITS	CONTENTS	Contact Hrs.
I	1. Elementary idea of stress and strain, Physiology of exposure to cold, heat, altitude, 2.Thermoregulation: Mechanism of thermoregulation in vertebrates, Ectotherms and Endotherms. 3. Excretion, Patterns of excretion, organs of excretion, Physiology of Urine formation 4. Respiration a. Respiratory pigments in animals, b. Transport of gases. Dissociation curve. Bohr's effect Root effect. c. CO transport, Haldane effect, Chloride shift. d. Hb and associated diseases: sickle cell anaemia & thalassemia	**08**
II	5. Histology of mammalian reproductive system - Testis, Ovary 6. Structure and function of Sertoli cell and Leydig cell. 7. Corpus luteum structure and functions 8. Histophysiology of Mammary gland.	**08**
III	9. Semen-composition and information 10. Pheromones and reproduction II. Hormone and Reproduction. 12. Hormonal regulation of implantation pregnancy Parturition, Placental hormones.	**08**
IV	13. Amino acids: Structure classification, properties due to different functional group (Ninhydrin reaction. Titration curve of amino acids) 14. Protein: Peptides and peptide bond, polypeptides and polyampholytes primary protein, secondary protein, tertiary protein, Ramachandran plot 15. conjugated protein. 16. Protein folding.	**08**
V	17. Structure and properties of Simple sugars polysaccharide. 18. Biochemical pathways and their regulation - Krebs cycle as metabolic mill. (Anaplerotic reaction) Key junction molecules - Glucose 6-phosphate, pyruvate, Acetyl Co-A 19. Enzyme - Kinetics and mechanism of action.	**08**

MSZG 1103: Population Genetics, Animal systematic & Evolution

UNITS	CONTENTS	Contact Hrs.
I	1. Population, Gene frequency, Hardy Weinberg's law in genetic stability 2. Variation in evolution - Sources of variability, Mutation, Genetic Recombination, Chromosome aberration, Natural Selection, Migration, Genetic Drift, Isolation Founder's principle.	**08**
II	3. Importance and application of biosystematics in biology. 4. International code of Zoological Nomenclature (ICZN-) principal interpretation and application, important rules.	**08**
III	5. Species and species concept. 6. Speciation and types of speciation. Models of speciation (allopatric, sympatric, parapatric) 7. concept of Evolution	**08**
IV	8. Theories of organic evolution with emphasis on Darwinism and its shortcomings 9. Synthetic theory of Evolution. 10. Selection in evolution: Types of Natural selection, Artificial, Selection 11. Patterns of evolution: Micro, Macro and Mega evolution, Evolutionary trends.	**08**
V	12. Pattern of nucleotide and amino acid sequence changes, Ecological significance of nucleotide and amino acid sequences changes. 13. Reproductive isolation - biological mechanism of genetic incompatibility	**08**

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MSZG 1104: Practical I

Scheme of examinations

Items	Marks Distribution
Dissection -2 (2x10)	20
Preparation of Permanent slide (Whole mount-1)	05
Spotting (slides 04, museum specimens 04 Bones 02) (10x2)	20
One experiment from Physiology and one from Biochemistry (5x2)	10
Determination of gene or genotype frequency/ Pedigree analysis	05
Records and Sessional work	10
Viva voce	10

List of Practical

- **Non-Chordate**
- **Dissections**
- General anatomy and nervous system of Leech, Prawn, Squilla, Scorpion, Aquatic beetle, Pila. Sepia. Mytilus, Aplysia, Sea urchin
- Museum specimens: Important representative of different invertebrate phyla showing peculiarities/ adaptive/features/ associations stages
- Specimens showing convergent and divergent evolution
- Specimens of connecting links and living fossils Limulus, Peripatus
- Specimens showing mimicry and melanism
- Slide of larval stage showing recapitulation of ontogeny (Helminths, Crustacean)
- Preparation of taxonomic key up to order of the following Coelenterate - Hydra, Obelia (medusa and polyp), Physalia, gorgonia, Aurelia, Metridium
- Rotifera – Brachionus
- Annelida- Earthworm, Tubifex, Nereis and Heteronereis, Arenicola, chaetopterus, Hirudo
- Arthropods - Sacculina on crab, Crab, Prawn, Lepus, Balanus, Butterfly, Water beetle, cyclops
- Mollusca- Chiton, Pila, Unio, Loligo, Sepia, Octopus, Aplysia, Dentalium
- Echinodermata - Asterias, Echinus, Antedon, cucumaria, Holothuria
- Slides of parasites showing adaptations (Protozoa, Helminthes, Arthropods)
- Study of the following using permanent slides -Trematode, Cestode, Nematode
- Larval stages in the life cycle of diagenetic trematodes
- Preparation of permanent slides (Protozoan parasites - rectal ciliates of vertebrates, glochidium larva) medusa, jaw of leech. parapodia of Nereis, gills of pila, Radula. book lung, trachea mouthparts of insects nephridia scales of fishes

Vertebrate Biology

Dissection

- Accessory respiratory organs in fish-Channa, heteropneustes Clarias, Anabas Cranial nerves and blood vessels in Labeo / Wallage Flight muscles and air sacs in chick

Museum studies

Models- Latimeria, Sphenodon. Ostrich, different types of beaks and feet in bird, nest of birds Specimens-Petromyzon, Myxine, Electric ray, Acipenser, Caecilian, Hyla/Rhacophorus, Axolotl larva Salamander, Draco, Phrynosoma, Turtle, Snake: cobra, Krait, Rattlesnake, sea snake, water snake, Bat

Bones - Skeleton of a bony fish, Chelonia, Snake, Dentition in mammals.

Physiology

- Measurement of metabolic rate in small animals' effect of stress on gill ventilation in fish plotting one of resistance and zone of tolerance
- Determination of blood pressure in man with help of Sphygmomanometer by auscultation method to show effects of exercise plotting time of acclimation.
- Detection of presence of blood by Benzidine test Preparation and study of hemin and haemochromogen crystals
- Determination of blood clotting time
- Total differential count
- Determination of haemoglobin content.
- Permeability of erythrocyte membrane as a function of osmolarity of salt solution.
- Effect of temperature, drugs, hormones and neurotransmitters on the rate of heart beat.

Biochemistry

- Isolation of starch from given material, isolation of casein from milk.
- Determination of glycogen content of rat liver calorimetrically
- Isolation of glycogen from rat liver and demonstration of effect of epinephrine on the glycogen yield from liver.
- Plotting the rate of an enzymatic reaction (assay of urease or amylase activity) and effect of rate limiting factors (Concentration of substrate and enzyme, pH, time, temperature) on it.
- Detection of acrolein in oil Emulsification of fat by bile salt Detection of double bonds in fat Test for cholesterol Chromographic detection of biochemicals
- Colorimetric estimation of Protein, Glucose, Cholesterol, Triglyceride, Na, K, Mg, DNA, RNA
- Evolution and Population Genetics
- Estimation of gene and genotype frequency from ABO blood group, PTC data Analysis of Pedigree

SEMESTER: SECOND

MSZG 1201: Developmental Biology and Endocrinology

UNITS	CONTENTS	Contact Hrs.
I	1. Fertilization: Specialization of the egg, structural specialization of sperm, Species-specific binding of gametes sperm-egg fusion, Capacitation. Acrosomal reaction. Prevention of polyspermy 2. Early development Nucleocytoplasmic interactions in early development Nuclear transplantation experiments in Amphibia 3. Morphogenetic substance and their role in development Chemical changes during cleavage Segregation and localization of morpho metric determinants, Segregation of germ cell determinants.	**08**
II	4. Cell differentiation Myogenesis (skeletal muscle - formation regeneration and hypertrophy). Differentiation of erythrocytes (stem cells and their diversification control of haemoglobin synthesis, erythrocyte membrane) 5. Genetic control of development: Genes controlling embryogenesis - determination of the embryonic axes (Drosophila), segmentation of larval body. Homeotic genes, Complex gene interaction in development Sequential gene action. Homeobox. 6. Post-embryonic Development: Metamorphosis in insect	**08**
III	7. Abnormal Development: Neoplasia 8. Pineal in vertebrates, its hormones and their function. 9. Comparative anatomy of endocrine glands and their hormones: Adenohypophysis. Neurohypophysis, Thyroid, Adrenal Parathyroid.	**08**
IV	10. Functions of the hormones secreted from - Hypothalamus (mammals only) II. Endocrinology of calcium regulation 12. Endocrinology of osmoregulation	**08**
V	13. Hormone and Homeostasis 14. Biosynthesis and secretion of Amino acid derived hormone (T^3T^4) IS. Biosynthesis of simple peptide hormones Pre and prohormones	**08**

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MSZG 1202: Environmental Biology and Ethology

UNITS	CONTENTS	Contact Hrs
I	1. Lindeman Trophic Dynamic concept, Energy Flow in Ecosystem, Food chain. Food web, Food Pyramid 2. Concept of Limiting factor Shelford's Law of tolerance, Liebig's Law of Minimum 3. Pollution Ecology it, Water, Bioremediation, Biosensors, Bioaccumulation, Biomagnification, food additive	**08**
II	4. Community Ecology: Component, Analytical and synthetic characters 5. Biodiversity: Status, monitoring and documentation. Major factors for biodiversity changes 6. Concept of Productivity Primary, Secondary and Tertiary factors and Methods of measurement	**08**
III	7. Environmental pollution - Definition, global scenario consequences and significance climate change, ozone layer, Greenhouse effect, Global warming 8. Population Characteristics and Interaction Competition and Niche theory - Intraspecific and interspecific competition Characteristics of community 9. Environmental economics, basic concept and its application	**08**
IV	10. Wildlife-their illegal trade and control, Wild life conservation techniques, Red Data Book. Categories of Endangered species 11 National projects: viz project tiger: project Elephant, Wildlife (Protection) Act 1972 12. General concept of Ethology Motivation, Fixed Action Pattern, Sign or key stimulus of releasers, Innate Releasing Mechanism Action specific energy. Learning of Experience. Imprinting. Physiological Basis of Behavioural Evolution of Behaviour.	
V	13. Behaviour and its types Individual and social interaction Social organization - in insects and Primates Innate and learned behaviour Anti predator behaviour Wildlife behaviour Reproductive behaviour 14. Perception of environment: Mechanical, Electrical, Chemical, Olfactory, Visual 15. Orientation in animals - its nature and types 16. Biological rhythms - occurrence and significance.	**08**

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MSZG 1203: Histology, Histochemistry, Tool and Techniques

UNITS	CONTENTS	Contact Hrs.
I	1. Fixation and tissue processing i. Types of fixatives ii. Chemistry of fixation and selection of fixatives 2. Sectioning of paraffin block staining of paraffin section: i. Principle and methods of staining	08
II	3. Histological stains Histochemical identification and localization of the following a. Glycogen and glycoprotein b. Protein end groups i. General protein localization by Mercury Bromophenol Blue ii. Proteins with NH group by Ninhydrin-Schiff iii. Proteins with - SS-groups by Performic acid-Schiff and Performic acid-Acid Blue c. Lipid moieties i. General lipid by Sudan Black B method ii. Neutral lipids by Sudan III and Sudan IV methods iii. Differentiation of neutral lipids by Nile Blue sulphate method d. Nucleic acids. i. DNA and RNA by Methyl green pyronin – y ii. DNA by Feulgen reaction	08
III	4. Principles and uses of analytical instruments: i. Spectrophotometer ii Spectroscopy - Atomic Absorption Spectroscopy 5. Microscopy and cryotechnique: Principles and working, Scanning and Transmission electron Microscope. 1.Cryopreservation of cells, tissues and organism.	08
IV	6. Separation techniques i. Separation by different types of chromatography (paper, TLC, GLC ion-exchange and HPLC) ii. Electrophoresis (Agarose and SDS Page) iii. Centrifugation: Basic principles of sedimentation	08
V	7. Magnetic resonance imaging (MRI) 8. ELISA 9. Mammalian Histology a. Liver b. kidney c. Stomach d. Bones and Cartilage	08

MSZG 1204: Practical II

	Full marks
1. Developmental Biology	10
2. Endocrinology	10
3. Environmental biology	10
4. Ethology	10
5. Histology & Histochemistry	10
6. Tools & Techniques	10
7. Records and Sessional work	10
8. Viva voce	10

List of Practical

1. Procedure of microtomy for animal tissue.
2. Morphometric measurements,
3. To sketch diagram of any tissue with the help of use of camera lucida.
4. Preparation of various types of fixatives and their uses.
5. Study of biochemical substances in the tissue with the help of Histochemical techniques.
a. Sudan Black
b. Bromophenol Blue
c. PAS reaction
6: Study of some tools - Autoclave, Colorimeter, pH meter, Tullgren apparatus
Electrophoresis.
7. Water analysis
a. Estimation of carbonate and bicarbonate in sample water.
b. Estimation of chloride in water.
8. Adaptation study.
a. Aquatic insects,
b. Fresh water fish
c. Higher vertebrates.
9. Identification of common aquatic plants, common plankton, Bioindicator species.
10. Reproductive biology
II. Endocrinology

SEMESTER: THREE

MSZG 2101: Biostatistics and Bioinformatics

UNITS	CONTENTS	Contact Hrs
I	1. Statistics and its applications, Primary and secondary data source 2. Frequency distribution Diagrammatic and graphic presentation of data 3. Range, Interquartile range. Mean deviation and standard deviation	**08**
II	4. Correlation: Definition types of correlation, Methods of studding correlation, Karl Pearson coefficient of correlation and rank correlation methods. 5. Regression analysis: Regression lines and regression equations. 6. Concept of sampling and sampling methods	**08**
III	7. Test of significance for large samples, small samples. 8. Chi-square analysis. 9. Probability distribution and their properties: normal Binomial Poisson distribution. 10. Evaluation of Biodiversity indices: Shannon-Weiner index 2x2 contingency table.	**08**
IV	11. Principles of bioinformatics and its application, concept of digital laboratory 12. Introduction to computer operating systems (Window), internet protocol and information technology. 13. Basics of home-pages, web-pages and uniform resource locater (URL) 14. Biological database: i. Nucleic acid sequence databases Genomic databases iii Protein sequence, structural and interacting proteins databases w Gene expression databases v Literature databases vi Biodiversity and ecosystem-based databases	**08**
V	15. Data retrival systems 1. Search engines ii. Entrez, Sequence retrieval systems (SRS) and protein identification resources (PIR) 16. Molecular sequence analysis software packages and tools: Biological information on the web. a. Motif, folds and domains b. BLAST, CLUSTALX, PHYLIP, Rasmol c. Primer designing 17. Applications and prospects of Bioinformatics Primer designing	**08**

MSZG 2102: Microbiology & Immunology

UNITS	CONTENTS	Contact Hrs
I	1. Methods in microbiology principles of microbial nutrition, Culture media, Theory and practice of sterilization, pure culture techniques, enrichment culture techniques for isolation of chemoautotroph. Chemoheterotroph, and photosynthetic microorganisms 2. Bacteria: Classification, Structure Bacterial growth and growth curve 3 Virus: Classification Structure of viruses Reproduction 4. Pathogenic microbes: HIV, Rabies, Foot and Mouth disease Prion Viroids	**08**
II	5. Antibiotics & Vaccines: Antibiotics & their mode of action Vaccine preparation methodology 6. Environmental Microbiology Bioremediation, Sewage treatment. Biofertilizers 7. Microbial disease and their control 8. Nonspecific Resistance and the immune Response.	**08**
III	9. Food and Industrial Microbiology 10. Biology of vertebrate Immune System, Innate and Acquired Immunity 11. Organization and structure of lymphoid organs 12. Cells of the immune system: T-cell, B-cell-generation activation and differentiation	**08**
IV	13. Lymphocyte traffic 14. Nature of antigens and superantigens. Antigenicity 15. Major Histocompatibility Complex in mouse and HLA system in human 16. Organization and expression of Ig genes, Generation of antibody diversity	**08**
V	17. Cytokines Structure and function and their receptors. 18. complement system component and functions 19. Hypersensitivity 20. Transplantation Immunology	**08**

MSZG 2103: Genetics & Cell Biology

UNITS	CONTENTS	Contact Hrs
I	1. Mendelian principles and deviation from Mendelian Inheritance Problem based on Mendelism. Extension of Mendelian principles codominance, incomplete dominance, gene interactions pleiotropy, sex limited and sex influenced traits 2. Gene mapping methods - linkage maps, mapping with molecular markers, 3. Structural and numerical alterations of chromosome - deletion, duplication, inversion, translocation - Robertsonian translocation ploidy and their genetic implications	**08**
II	4. Recombination, site-specific recombination 5. Transposons 6. Extra chromosomal inheritance - inheritance of mitochondrial and chloroplast genes. 7 Effect of environment on the expression of gene and characters.	**08**
	8. Sex determination in Drosophila and human - Role of alternate splicing, role of SRY gene SXL-gene. 9. Bio membrane, Molecular organization, Fluid - Mosaic model Transport across the cell membrane, membrane potential. 10 Cell-cycle-Cyclins and CDK, Regulation of CDK-Cyclin activity 11 Oxidative phosphorylation.	
IV	12. Cell signalling-cell surface receptors Second messenger system. MAP Kinase-pathways. 13. Nucleus- Structure of Nuclear membrane and nuclear transport 14. Cytoskeleton- Assembly of cytoskeleton filaments Molecular motors and their roles intermediate filaments 15. Biology of Chromosome - Ultra structure of Chromatin fibre.	**08**
V	16. Telomere and its maintenance. 17. Programmed cell death (Apoptosis) 18. Stem cell a concept : Hematopoietic stem cells 19. Protein Trafficking: Protein synthesis on free and bound polysomes, uptake into ER, membrane. Protein Golgi sorting. Post translational modification, trafficking mechanism	**08**

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MSZG 2104: Practical III

Practical	Full marks
1. Biostatistics	10
2. Bioinformatics.	10
3. Microbiology	10
4. Immunology	10
5. Genetics	10
6. Cell Biology	10
7 Records and Sessional work	10
8. Viva voce	10

1. Microbiology & Immunology Media Preparation

a. Media preparation
b. Bacterial culture and staining
C. Study of linkage map from given sample
d. Study of polytene chromosome
e. ELISA test using kit

2. Quantitative Biology

a. Measurement of central and dispersal tendencies.
b. Performance of X^3 test on sampled data.
c. Test for correlation
d. Measurement of dominance, evenness and species diversity of generated data
e. Species area curve for sampling population by quadrat method.

3. Bioinformatics

a. Familiarization with computer operations
b. Data archiving systems.
C. Use of search engines - Google
d. Demonstration of web - pages related to biological information NCBI
e. Use of data bases - Gene Bank, PubMed
f. Demonstration and practice of software packages BLAST, clustal etc.

4. Cell Biology & Genetics

a. Study of common mutants in Drosophila.
b. Detection of blood group frequency in human population.
c. Study of Mendelian ratio using seeds sample
d. Preparation of slides of cell division.

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SEMESTER: FOUR

MSZG 2201: Elective Theory I: Molecular Biology

UNITS	CONTENTS	Contact Hrs.
I	DNA Structure, family Quadruplex DNA and its significance, Interrupted genes, Gene families. Unique and repetitive DNA. Transposons. overlapping DNA 2. DNA replication 3. DNA damage and repair	**08**
II	4. Site specific recombination, Role of DNA BCD protein. Rec A protein, Holliday junction and branch migration 5. Gene expression i. Transcription in prokaryotes, ii. Translation in prokaryotes iii. Transcription in eukaryotes a) 5- cap formation b) 3-poly A tail addition c) RNA processing d) RNA export 6. Spatial and temporal regulation of gene in Eukaryotes	**08**
III	7. Molecular control of transcription in Eukaryotes: 8. Gene silencing: DNA methylation, Histone code, RNA interference 9. Gene regulation Operon concept. Lac operon, Tryptophan operon. Arabinose operon. Role of catabolic repressor and IPTG	**08**
IV	10. Use of recombinant DNA technology to identify human disease - Huntington's disease, and cystic Fibrosis. 11. Genetics and cancer. 12. DNA Fingerprinting	**08**
V	13. RFLP 14. Life cycle of Virus, Lytic and Lysogenic pathway, Role of (lambda) repressor 15. C-value paradox, Gene amplification, Doses compensation,	**08**

MSZG 2202: Elective Theory II: Biotechnology

UNITS	CONTENTS	Contact Hrs.
I	1. Basic principles of genetic engineering. i. Enzymology - restriction enzymes, DNA Ligase, polymerase. ii.Cloning Vehicles - Plasmids, Cosmids, A (lambda)- phage, Shuttle vectors, Ti- plasmid, YAC. 2. Introduction of cloned genes into host cells. i. Transformation, Transduction, Particle gun electroporation, Liposome.	10
II	.3. Analysis and expression of cloned genes in host cells i. RFLP, RAPD, AFLP analysis. ii.PCR, DNA probes, expression of genes. 4. Gene libraries i. Construction and analysis of CDNA library, application of gene library, YACS. ii.Genomic DNA library.	10
III	5. Changing genes i. Site directed mutagenesis. ii. Protein engineering. 6. Molecular biotechnology of Microbial system i. Production of pharmaceutical enzymes, ii. Monoclonal antibody iii. Production of Vaccines. iv. Production of single cell protein	10
IV	7. Transgenic animals 8. Human gene therapy. i. Viral gene delivery system. ii. Non viral gene delivery system iii. Prodrug activation therapy. iv. Nucleic acid as therapeutic agent. Oligonucleotide correction of genetic system 9. Patenting biotechnology inventions, ethical issues and biosafety regulations	10

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MSZG 2203: Project/Dissertation
Topic given by the Department council during 3rd Semester

Practical special paper	Full Marks
1. Use of an Instrument	10
2. Use of a micropipette	10
3. Detection of concentration of solute in the sample with the help of Lambert beer law	15
4. Isolation of DNA	15
5. Separation of molecules with the help of chromatography / Electrophoresis	10
6. Records and Sessional work	10
7. Viva voce	10

Use of Autoclave
Use of Laminar flow
Use of Micropipette
Use of Centrifuge
Preparation of gel
Use of colorimeter
Use of Spectrophotometer
Use of ELISA plate reader
Isolation of DNA
Isolation of Protein
Use of PCR

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