VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN BIOTECHNOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN BIOTECHNOLOGY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	3rd	V	SEMESTER-V							
			Major-8	BITHMJ08	T: Molecular Biology; P: Practical	4	3-0-1	15	60	75
			Major-9	BITHMJ09	T: Chemistry-2(Organic Chemistry); P: Practical	4	3-0-1	15	60	75
			Major-10	BITHMJ10	P: Bioprocess Technology; P: Practical	4	3-0-1	15	60	75
			Major Elective-01	BITHDSE1	Medical Microbiology OR Plant Diversity-I	4	3-0-1	15	60	75
			Minor-5 (Disc.-I)	BITMIN05	T: Developmental Biology; P: Practical *(To be taken from other Discipline)*	4	3-0-1	15	60	75
			Semester-V Total			20				375
		VI	SEMESTER-VI							
			Major-11	BITHMJ11	T: Immunology; P: Practical	4	3-0-1	15	60	75
			Major-12	BITHMJ12	T: Recombinant DNA Technology; P: Practical	4	3-0-1	15	60	75
			Major-13	BITHMJ13	T: Bio-Analytical Tools; P: Practical	4	3-0-1	15	60	75
			Major Elective-02	BITHDSE2	Animal Biotechnology OR Animal Diversity I	4	3-0-1	15	60	75
			Minor-6 (Disc.-II)	BITMIN06	T: Fundamentals of Genetics; P: Practical *(To be taken from other Discipline)*	4	3-0-1	15	60	75
			Semester-VI Total			20				375
			YEAR-3			40				750
			Eligible to be awarded Bachelor of Science in Biotechnology *on Exit*			126	Marks (Year: I+II+III)			2325

MJ = Major, MI = Minor Course, DSE = Discipline Specific Elective Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

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SEMESTER-V

MAJOR (MJ)

MJ-8: Molecular Biology **Credits 04 (Full Marks: 75)**

MJ-8T: Molecular Biology (Theory) **Credits 03 (45 Lectures)**

Course contents:

UNIT I: DNA structure and replication

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT III: Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.

MJ-8P: Molecular Biology (Practical) **Credits 01 (30 hrs.)**

Practical:

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method

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4. Agarose gel electrophoresis of genomic DNA & plasmid DNA

5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

Suggested Readings:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

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MJ-9: Chemistry-2(Organic Chemistry) **Credits 04(Full Marks: 75)**

MJ-9T: Chemistry-2(Organic Chemistry) (Theory) **Credits 03 (45 Lectures)**

Course contents:

1. Alkane structural formulae, Nomenclature, Homologous series, Alkene, Conformational analysis, Alkenes and alkynes, orbital picture.
2. Monohydric alcohol, polyhydric alcohols, unsaturated alcohols, ether, carbonyl compounds and acids.
3. Stereochemistry: Different types of isomerism-Geometric and Optical isomerism, Diisomerism, Enantiomers, Chirality and asymmetricity in relation to biomolecules.Mesomerism,Racemic modifications. Steriochemical nomenclature. R-S, EZ, DL, Pro-R, Pro-S, Erythro and threo designations of enantiotropic atoms. Fischer, Newman, Sawhorse and Wedge structures and their interconversation.
4. Aliphatic compounds of sulphur, phosphorous, organometallic compounds.Grignard Reagent and use.
5. Nomenclature of aromatic compound. Reaction mechanism : SN1 and SN2 reaction, E1and E2 reaction of organic reactions. Saytzett and Hoffmann elimination. Neucleophilic and Electrophilic aromatic substitution. Aromaticity orbital picture, Electrometric effect, mesomeric effect. Resonance and delocalization of π electrons in different organic compounds.
6. Spectroscopy : idea of electromagnetic radiation orbital theory, Concept of orbital Beer's Law and its importance. Fluoroscence spectroscopy. Steady state fluorescence application in biology, UV-VIS spectroscopy.

MJ-9P: Chemistry-2(Organic Chemistry) - lab. **Credits 01 (30 hrs.)**

Practical:

Detection of special elements (N,S,Cl) and any one of the following functional groups in solid organic compounds : -NH2 , -NO_2 , -$CONH_2$, phenolic-OH, COOH, =CO, -CHO.

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MJ-10: Bioprocess Technology **Credits 04(Full Marks: 75)**

MJ-10T: Bioprocess Technology (Theory) **Credits 03 (45 Lectures)**

Course contents:

UNIT I

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

UNIT III

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

MJ-10T: Bioprocess Technology (Practical) **Credits 01 (30 hrs.)**

Practical

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

Suggested readings:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

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MAJOR ELECTIVE (DSE)

Major Elective -1: Medical Microbiology **Credits 04(Full Marks: 75)**

MJ DSE-1T: Medical Microbiology (Theory) **Credits 03**

Course contents:

UNIT I

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus, S.pyogenes, B.anthracis, C.perferinges, C.tetani, C.botulinum, C.diphtheriae M.tuberculosis, M. leprae.*

UNIT II

Morphology, pathogeneis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli, N. gonorrhoea, N. meningitidis, P. aeruginosa, S. typhi, S. dysenteriae, Y. pestis, B. abortus, H. influenzae, V. cholerae, M. pneumoniae, T. pallidum M. pneumoniae, Rickettsiaceae, Chlamydiae.*

UNIT III

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

UNIT IV

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton, Microsporun and Epidermophyton*) Subcutaneous infection (*Sporothrix, Cryptococcus*), systemic infection (*Histoplasma, Coccidoides)* and opportunistic fungal infections (*Candidiasis, Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

MJ DSE-1P: Medical Microbiology (Practical) **Credits 01 (30 hrs.)**

Practical

1. Identification of pathogenic bacteria (any two) based on cultural, morphological and biochemical characteristics.
2. Growth curve of a bacterium.
3. To perform antibacterial testing by Kirby-Bauer method.
4. To prepare temporary mounts of Aspergillus and Candida by apprpriate staining.
5. Staining methods: Gram's staining permanent slides showing Acid fast staining, Capsule staining and spore staining.

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Suggested Readings:

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

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Major Elective -1: Plant Diversity I **Credits 04(Full Marks: 75)**

MJ DSE-1T: Plant Diversity I (Theory) **Credits 03**

Course Content:

UNIT I Algae:
General character, classification and economic importance. Life histories of algae belonging to various classes:
Chlorophyceae – *Volvox, Oedogonium*
Xantho phyceae –*Vaucheria*
Phaeophyceae – *Ectocarpus*
Rhodophyceae-*Polysiphonia*

UNIT II Fungi:
General characters, classification & economic importance.
Life histories of Fungi:
Mastigomycontina- *Phytophthora* Zygomycotina-*Mucor*
Ascomycotina- *Saccharomyces*
Basidomycotina-*Agaricus*
Deutromycotina-*Colletotrichum*

UNIT III Lichens :
Classification, general structure, reproduction and economic importance.
Plant diseases: Casual organism, symptoms and control of following plant diseases.
Rust & Smut of Wheat.
White rust of Crucifers.
Late blight of Potato.
Red rot of Sugarcane.
Citrus Canker.

UNIT IV Bryophytes:
General characters, classification & economic impotance.
Life histories of following:
Marchantia.
Funaria.

MJ DSE-1P: Plant Diversity I (Practical) **Credits 01**

Course Outline:

Practical
1. Comparative study of thallus and reproductive organs of various algae mentioned in theory
2. Comparative study of vegetative and reproductive parts of various fungi mentioned in theory.

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3. Study and section cutting and lectophenol mount of plant disease materials studied in theory.
4. Study of various types of lichens.
5. Study of external features & anatomy of vegetative and reproductive parts of Marchantia and Funaria
6. Collection of algae, fungi, plant diseases materials and bryophytes available locally.

Suggested Readings:

1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4th edition, John Wiley and Sons (Asia) Singapore.
3. Bold, H.C. & Wayne, M.J. 1996 (2nd Ed.) Introduction to Algae.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.
5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.
8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
9. Vander-Poorteri 2009 Introduction to Bryophytes. COP.
   Webster, J. and Weber, R. 2007 Introduction to Fungi. 3 rd edition, Cambridge University
10. Press, Cambridge.
11. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

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MINOR (MI)

Minor (MI)-5: Developmental Biology **Credits 04(Full Marks: 75)**

Minor (MI)-5T: Developmental Biology **Credits 03**

Course contents:

UNIT I: Gametogenesis and Fertilization

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

UNIT II: Early embryonic development

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

UNIT III: Embryonic Differentiation

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT IV: Organogenesis

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals**.**

Minor (MI)-5P: Developmental Biology **Credits 01 (30 hrs.)**

Practical:

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles*.
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs..
5. Study of different types of placenta.

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Suggested Readings:

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

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SEMESTER-VI

MAJOR (MJ)

MJ-11: Immunology **Credits 04 (Full Marks: 75)**

MJ-11T: Immunology (Theory) **Credits 03 (45 Lecture)**

Course contents:

UNIT I

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T- lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT II

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT III

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

UNIT IV

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

MJ-11P: Immunology (Practical) **Credits 01 (30 hrs.)**

Practical:

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

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Suggested Readings

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition GarlandScience Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

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MJ-12: Recombinant DNA Technology **Credits 04 (Full Marks: 75)**

MJ-12T: Recombinant DNA Technology (Theory) **Credits 03 (45 Lectures)**

Course contents:

UNIT I

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT IV

Genetic engineering in plants: Use of Agrobacterium *tumefaciens and* A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

MJ-12P: Recombinant DNA Technology (Practical) **Credits 01 (30 hrs.)**

Practical

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

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Suggested Reading:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

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MJ-13: Bio-Analytical Tools **Credits 04 (Full Marks: 75)**

MJ-13T: Bio-Analytical Tools (Theory) **Credits 03 (45 Lectures)**

Course contents:

UNIT I

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications**.**

MJ-13P: Medical Microbiology (Practical) **Credits 01 (30 hrs.)**

Practical

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

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Suggested Reading:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

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MAJOR ELECTIVE (DSE)

Major Elective -2: Animal Biotechnology **Credits 04(FM: 75)**

MJ DSE-2T: Animal Biotechnology (Theory) **Credits 03**

Course contents:

UNIT I
Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II
Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT III
Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV
Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

MJ DSE-2P: Animal Biotechnology (Practical) **Credits 01**

PRACTICALS

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.
8. Resolving DNA on Agarose Gel.

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Suggested Readings:

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic
2. Press, California,USA.
3. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
4. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
5. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
6. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

OR

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Major Elective -2: Animal Diversity I **Credits 04(Full Marks: 75)**

MJ DSE-2T: Animal Diversity I (Theory) **Credits 03**

Course contents:

UNIT I

a) Outline of classification of Non- Chordates upto subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes.
b) Protozoa: Locomotion, Reproduction, evolution of Sex, General features of *Paramoecium* and *Plasmodium*. Pathogenic protozoans
c) Porifera: General characters, outline of Classification; skeleton, Canal System

UNIT II

a) Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.
b) Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations.
c) Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

UNIT III

a) Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features of Earthworm, Vermicomposting.
b) Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

UNIT IV

a) Mollusca: general features, Outline of classification, Shell Diversity; Torsion in gastropoda,
b) Echinodermata: General features, Outline of Classification Larval forms
c) Hemichordata: Phylogeny: Affinities of *Balanoglossus*

MJ DSE-2P: Animal Diversity I (Practical) **Credits 01**

1. Identification and Classification of Any these of the following –
   Porifera*: Scypha, , Leucosolenia, Euspongia, Hylonema, Euplectella Cnidaria: Medrepora, Millepora, Physalia, Porpita, Valella, Aurelia, Metridium* Platyhelminthes: *Taenia, Fasciola*, Aschelminthes*: Ascaris, Ancylostoma, Enterobius* Annelida: *Pheretima, Hirudinaria, Chaetopterus, Nereis, Aphrodite* Arthropoda: *Julus, Scolopendra, Peripatus, Carcinus, Limulus, Lepisma, Dragonfly, Musca, Acheta* Mollusca: *Pila, Unio, Mytilus, Loligo, Sepia, Octopus, Solen* Echinodermata: *Asterias, Ophiothrix, Echinus, Holothuria, Astrophyton* Hemichordata: *Balanoglossus*

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2. Identification of slides with two points of identification.
   Amoeba, Paramoecium, Ceratium, Plasmodium, Opalina, L.S. Sponge,Spicules of sponges, L.S. *Hydra, Obelia, Bougainvillia*, Larvae of *Fasciola*, Seta of Earthworm, Radula
3. Ecological Note – On any of the specimens in Exercise No 1
4. Models of dissection of Earthworm, Cockroach
   Earthworm: Digestive, Nervous System,
   Cockroach: Digestive Reproductive, Nervous System

Suggested Readings

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
2. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
3. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
4. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
5. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-HillCompanies.

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MINOR (MI)

Minor (MI)-6: Fundamentals of Genetics **Credits 04(Full Marks: 75)**

Minor (MI)-6T: Fundamentals of Genetics (Theory) **Credits 03**

Course contents:

UNIT I

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X- syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes

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in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.
Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.
Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

Minor (MI)-6P: Fundamentals of Genetics (Practical) **Credits 01**

Practical:

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -*Rhoeo* translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

Suggested Readings

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

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