



# Government Arts and Science College Ratlam (M. P.) 457001



Phone: 07412 - 235149

E-mail: hegaaspgcrat@mp.gov.in, pgcolrtm@hotmail.com

For the session 2021-22 the syllabus applied respectively in UG I is adopted from Central Board of Studies Bhopal designed according to NEP2020. For UG II and III and PG the syllabus of the previous session have been followed.

  
Principal

Govt. Arts and Science College

Ratlam (M.P.)  
**Principal**  
Govt. Arts & Science College  
Ratlam (M.P.)

① 7032

**VIKRAM UNIVERSITY, UJJAIN**  
**M.Sc. BIOTECHNOLOGY**  
**CURRICULAR 2015-16**

Semester	Title of paper	Theory/ Practical	Marks Internal Assessment	Total
First	101 Cell and Molecular Biology	40	10	50
	102 Immunology and Molecular Diagnostics	40	10	50
	103 Molecular Endocrinology and Reproductively Technology	40	10	50
	104 Microbiology	40	10	50
	Lab course I	50	-	50
	Lab course II	50	-	50
	Project Work	50	-	50
	<b>Total Marks</b>			

Semester	Title of paper	Theory/ Practical	Marks Internal Assessment	Total
Second	201 Enzyme technology	40	10	50
	202 Environmental Technology	40	10	50
	203 Biomolecular and Metabolism	40	10	50
	204 Bioinstrumentation	40	10	50
	Lab course I	50	-	50
	Lab course II	50	-	50
	Project Work	50	-	50
	<b>Total Marks</b>			

Semester	Title of paper	Theory/ Practical	Marks Internal Assessment	Total
Third	301 Genetics Engineering	40	10	50
	302 Bioprocess Engineering and Bioinformatics	40	10	50
	303 Part-I Industrial Biotechnology Part-II Animal Cell culture	40	10	50
	304 Plant Biotechnology	40	10	50
	Lab course I	50	-	50
	Lab course II	50	-	50
	Project Work	50	-	50
	<b>Total Marks</b>			

Semester	Title of paper	Theory/ Practical	Marks Internal assessment
Fourth	<b>Project Work</b>		
	Project Report	200	-
	Project Viva voice	200	-
	<b>Total Marks</b>	<b>400</b>	

Evolution by both internal and External examiner at the time of Presentation. These will be weekly examiner and continues comprehensive examination system thought the course EA=.

*M. Parilau* *hrr* *ABL* *Q*

# Semester 1- paper -I

## 101. CELL AND MOLECULAR BIOLOGY

2

### UNIT -1

1. Molecular organization of Eukaryotic Plasma Membrane based on Fluid Mosaic Model
2. Transport across Plasma Membrane: Passive diffusion, facilitated diffusion, Active transport, Symport, Uniport and Antiport.
3. Cell Signaling: Modes off cell-cell signaling.
4. Microtubules: Structure, assembly, instability, role of dynein and kinesin (motor proteins) in organelle movement

### UNIT-2

1. Rough Endoplasmic Reticulum (RER): Role in the synthesis, modification and targeting of proteins.
2. Eukaryotic Cell Cycle: Check points, genetic regulation by CdK & cyclins.
3. Biology of Cancer: Types, development and causes.
4. Apoptosis: Definition, mechanism and significance.

### UNIT-3

1. Nuclear Envelope (NE): Ultra structure of pore complex, import of proteins and transport of RNA.
2. Metaphase chromosome: Molecular organization of chromatin based on nucleosome concept, nuclear scaffold
3. Genomic organization in Eukaryotes: 'C' value paradox, repetitive and non repetitive DNA.
4. Molecular structure of DNA: A, B and Z forms.

### UNIT-4

1. Molecular mechanism of replication of prokaryotic DNA.
2. DNA damage and repair: general process.
3. Genetic code: Universal and exceptional.
4. Transcription in Prokaryotes: Typical features.

### UNIT-5

1. Transcription in Eukaryotes: Typical features
2. Translation: The general process in prokaryotes and eukaryotes.
3. Gene regulation in Prokaryotes (lac-operon): Repressor and induction, positive and negative control, gratuitous inducer (IGPT).
4. Gene regulation in Eukaryotes: Different levels of regulation of gene expression.

McPaukan  
hor

LAL  
Dy

REFERENCES BOOKS :

1. Molecular cell Biology: J. Darnell ,H.Lodish and D. Baltimore scientific American book,inc. USA.
2. Molecular Biology of the cell: B.Alberts, D.Bray , J.Lewis ,M.Raff, and J.D.Watson ,Garland Publisher inc. N.Y.
3. The science of genetics : Atherly , A.G., J.R. Girton and J.F. Mc Donald, Saunders college publishing Co. ITP N.Y.
4. Genetics : Analysis and Principles : Brooker R.J. Benjamin / Cummings, Longman .inc.
5. Genetics : The continuity of Life , Fairbanks, D.J. and W.R. Anderson, Brooks / cole Publishing co. ITP NY,
6. Principal of Genetics : Gardner, E.J. , M.T. Simons and D.P. Snustad Inc.
7. Genes VI & VII Lewin , B. Oxford University.
8. Molecular Biology of Gene : Watson I.D., N.H. Hopkins, J.W. Roberts ,and Weiner The Benjamin Pub. Co. inc.Tokyo.
9. Principal of cell & Molecular Biology : Lewish j.Klensmith and M.Kish , Harper Collins College Pub. USA.
10. The cella Molecular Approach : Geoffrcy M.Cooper ,ASM Press DC.USA.
11. Concept of Genetics : Williams S. Klug and Michael R. Cummings, Prentice Hall International Inc. USA.

LIST OF PRACTICALS:

1. Study of chromosome behavior during Mitosis & Meosis.
2. Calculation of mitotic index in growing root tips.(onion/garlic)
3. Influence of chemical (insecticide / drug ) on Mitosis and observe breakage of chromosomes at anaphase .
4. Barr- Body(sex-chromatin ) preparation in buccal epithelial cells.
5. Chromosomes bridge & Lagging chromosomes in permanent Slids
6. Culture of locally available **Drosophila** w.m. preparation of eggs, larva, adult Male & female .
7. Squash preparation : polytene chromosomes in the larva salivary gland of locally available **Drosophila** OR chieronomus .
8. Study of liver OR whole mount preparation (slide) of **Drosophila** mutants obtained from recognized stock center only.
9. Demonstration of mitochondria by vital staining.
10. Use of Light Microscope, calculation of magnification , measurements of cell nucleuse NC ratio , counting cells/ field (hepatic OR testicular )
11. Colorimetric estimation of glucose , cholesterol , protein , RNA & DNA., ascorbic acid.
12. Absorption spectra of any colored solution of a substance.
13. Chromatography of **Drosophila** eye pigment.

McParison      HSR      [Signature]

**Semester-1 Paper -2**  
**Immunology and Molecular Diagnostics**

**Unit- 1**

1. Components of innate and acquired immunity.
2. Component and inflammatory responses
3. Organ and cells of the immune system: primary and secondary lymphoid organ.
4. Major histocompatibility complex.

**Unit- 2**

1. Immunoglobulin: structure and classes
2. B cell maturation, activation and differentiation
3. T cell maturation, activation and differentiation
4. Cell mediated immune responses.

**Unit-3**

- 1 Monoclonal antibodies and their role in cancer
- 2 Recombinant vaccines and clinical applications
- 3 RFLP and DNA sequencing in the clinical diagnostics.
- 4 Real time PCR methodologies in clinical diagnostics.

**Unit- 4**

- 1 Microchips and Taqman
- 2 Microarray in the analysis of gene expressions
- 3 Analysis of DNA methylation, methylation in health and disease
- 4 General procedure and clinical application of fish.

**Unit- 5**

- 1 Protein based molecular diagnostics e. g. immunoproteomics, ELISA and western blotting applications.
- 2 Molecular diagnostics of some common genetic and non- genetic diseases e.g. trinucleotide repeats, fragile X Syndrome.
- 3 Molecular diagnostics of diabetes mellitus and cystic fibrosis
- 4 Genetic counselling and genetic testing.

M. Prasad

hsp

DL

Q

REFERENCES: -

1. Immunology by Janis Kuby.
2. Essential Immunology By IM.Roitt ELBS edition,.
3. Fundamentals of Immunology by William Paul.
4. Immunology : An Introduction by Tizzart
5. Advance Immunology by David Male & others .
6. A Hand Book of Practical and clinical Immunology by G.P.Talwar & S.C.Gupta.
7. The enzyme linked Immunosorbent assay (ELISA) - Volume 1 & 2 by Alister Voller and Danis Bidwell.
8. W.B. coleman & GJ Tsongalis Molecular diagnosis for the clinical Laboratories, 2<sup>nd</sup> edition
9. Francesco falciani, Microarray technology through Applications, Taylor & Francis,2007
10. Jochen decker , Molecular diagnosis of Infectious diseases, Humana Press.

PRACTICALS

1. Blood film preparation and identification of cell.
2. Demonstration of lymphoid organs and their microscopic Examination .
3. Immunization and production polyclonal antibodies
4. Immunodiffusion.
5. Agglutination .
6. ELISA Antibody capture Elisa
7. ELISA Antigen capture Elisa.
8. Sepration of mononuclear by Ficoll Hypaque .
9. Bledding of animals by different Routes.
10. Blood Group Antigen.
11. Specific primer designing
12. Extraction of nucleic acids (DNA & RNA) & Proteins
13. Primer designing.

M. Saurav hsk LAL = 

**SEMESTER - I BIOTECHNOLOGY PRACTICAL EXAMINATION - I**  
(6 hrs. )

**Based on theory Papers 101 & 102**

---

1.	Cytological Exercise - 1 .....	4 Marks
2.	Cytological Exercise - 2 .....	4 Marks
3.	Cytological Exercise - 3 .....	4 Marks
4.	Cytological Exercise - 4 .....	4 Marks
5.	Spotting based on cytogenetics & Immunology .....	8 Marks
6.	Immunological Exercise - 1 .....	5 Marks
7.	Immunological Exercise - 2 .....	5 Marks
8.	Immunological Exercise - 3 .....	6 Marks
9.	Viva - Voce .....	5 Marks
10	Practical Record .....	5 Marks

---

**Total Marks - 50**

---

Aspiran  
by  
2023  
Oy



**103. MOLECULAR ENDOCRINOLOGY AND REPRODUCTIVE TECHNOLOGY**

**UNIT -1 :**

1. Definition and scope of molecular Endocrinology .
2. Chemical nature of Hormones.
3. Purification and characterization of Hormones.
4. Production of Hormones by DNA technology.

**UNIT - 2**

1. Hormones receptors – Identification, quantitation, purification, and physico chemical properties.
2. Membrane receptors Structure and signal transduction Mechanism .
3. Nuclear receptors –Structure and function , orphan receptors .
4. Neurohormones as neural messengers.

**UNIT - 3**

1. Eicosanoids and Hormones action.
2. Molecular mechanism of prostaglandin metabolism.
3. Hormonal regulation of energy metabolism.
4. Genetic analysis of hormonal disorders.

**UNIT - 4**

1. Contraception.
2. Multiple ovulation and embryo transfer technology.
3. Study of estrus cycle by vaginal smear technique.
4. Surgical technique - castration , ovariectomy ,vasectomy, tubectomy and laprotomy.

**UNIT - 5**

1. Sex determination.
2. Embryo sexing and cloning
3. Hormones and ageing.
4. Transcriptional and post Transcriptional regulation of Hormones .

*U. Sankar*

The image shows two handwritten signatures or initials in black ink. The first one on the left is a cursive signature that appears to be 'U. Sankar'. The second one on the right consists of a large, stylized 'U' followed by a smaller 'S' and a horizontal line underneath, likely representing the same name.



REFERENCE BOOKS :

1. Benjamin Lewin – Genes VII / VIII, oxford University press.
2. Lodish etal – Molecular Cell Biology .
3. Ethan Bier – The coiled spring Harbor press.
4. Freedman L.P., Molecular biology of steroid and nuclear hormone receptors.
5. Litwack, G. – Biochemical action of Hormones , Academic press.
6. Zarrow , M.X. yochin J.M. and Machrthy , J.L. – Exprimental endocrinology.
7. Chatterjee C.C. – Human Physiology (vol.II )
8. Bentley , P.J.- Comparative Vertebrate endocrinology.
9. Hadley Mac.E. – Endocrinology.
10. Greenstein ,B. – Endocrine at a glance.
11. Puri C.P. and varlook , P.R. – Current concepts of fertility regulation and reproduction .
12. Austin ,C.R. and frshort ,R.V. – Reproduction in mammal.
13. Chinoy,N.J.Rao,M.V., Desaraj ,K.J. and High Land ,H.N. –Essential Techniques.
14. Jubiz, W. – Endocrinology: A logical approach for clinicians.
15. Horrobin,D,F. Essantial biochemistry ,Endocrinology and nutrition.
16. Norris,D.O. – Vertebrate Endocrinology.
17. Austen, C.R. and short ,R.V. –Reproduction in animals .
18. Edwards, R.G. – Human Reproduction.

PRACTICAL EXERCISES :

1. Bioassay of any hormone involving target tissue growth / differentiation.
2. Radioreceptor assay for any hormone .
3. RIA and ELISA for any hormone or second messenger.
4. Purification of any protein hormone .
5. Assay of steroid dehydrogenase.
6. Isolation and characterization of steroid / prostaglandin .
7. Gel retardation assay for transcription like protein .
8. Assay for protein phosphorylation c AMP dependent protein – Kinase.
9. Guanylcyclase assay in vitro.
10. Histological studies of endocrine gland.
11. Cytological studies of endocrine gland.
12. Histochemical studies of endocrine gland.
13. Study of vaginal histological during estrus cycle.
14. Demonstration of estrus cycle study by vaginal smear technique .
15. Histological demonstration of glycogen during reproductive cycle and pregnancy.
16. Effect of testosterone, estradiol and progesterone.

- (a) Male reproductive study by Weight/ volume Measurement .  
 (b) Female reproductive structure by Weight/ volume Measurement
17. Study of accessory reproductive structure after castration or ovariectomy
18. Sperm count .
19. Demonstration of surgical techniques.  
 (a) castration (b) Ovariectomy (c) Laparotomy (d) Parabiosis (e) vasectomy  
 (f) tubectomy etc.
20. Demonstration of perfusion technique for the fixation of endocrine tissue.
21. Implantation of endocrine gland / tissue.

9

**SCHEME OF PRACTICAL EXAMINATION :-**

**4 hr.**

1.	Experiment on molecular endocrinology / reproductive technology	10.
2.	Surgical / Experimental techniques	10.
3.	Histological technique	08
4.	Spotting (1-5)	10
5.	Viva - voce	05
6.	Record	07

**Total Marks 50**

*MSR* *MSR* *MSR* *MSR*

104. MICROBIOLOGY

UNIT – 1

1. Classification of Microorganisms : Basis of Microbial Classification, Haeckel Three Kingdom , Whittaker's five Kingdom concept.
2. Morphology and fine structure of eubacteria and archeobacteria cell wall, cytoplasmic membrane and other organells.
3. Pure culture techniques and preservation methods.
4. Preparation of Culture media, microbial staining.

UNIT – 2

1. Sterlization: Physical and chemical methods .
2. Microbial Growth : Bacterial growth curve, mathematical expression , measurement of growth and factors affecting growth.
3. Microbial Nutrition : Nutritional classification of Microorganisms, common nutritional requirements, mode of nutrition, transport of nutrients across the bacterial membrane.
4. Oxygen toxicity: study of catalase, peroxides , superoxide dismutase, mechanism of oxygen toxicity.

UNIT – 3

1. Virus : Types, Isolation , Cultivation , Identification, and viral replication.
2. Structure and morphology of Bacteriophage, lytic and lysogenic cycle.
3. Life cycle of DNA. Viruses : SV 40, RNA. Viruses : Retroviruses.
4. Cyanobacteria : General account and their importance.

UNIT – 4

1. Infection and diseases ,type of Infection , Mechanism of pathogenecity.
2. Bacterial Diseases : Staphylococcal and Clostridial food poisoning , Salmonellosis Shigellosis.
3. Fungal diseases , Histoplasmosis, Aspergillosis.
4. Viral Diseases : Chicken Pox , Hepatitis B, and Poliomyelitis.

UNIT – 5

1. Mycoplasmas and diseases caused by them .
2. Bacterial Recombination : Transformation , Conjugation, Transduction, Plasmids and transposons
3. Chemotherapeutic agents : Classification of antibiotics, Broad spectrum antibiotics, Antibiotics from prokaryotes.
4. Anti- fungal and antiviral antibiotics, mode of action of antibiotics and resistance to antibiotics.

*M. Parulekar* *hsk* *hsk* *Qy*

### PRACTICAL EXERCISES:

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of Microorganisms.
3. Isolation of pure cultures from soil and water.
4. Growth; Growth curve; Measurement of bacteria population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
5. Microscopic examination of bacteria, Yeast and molds and study of organism by gram stain, Acid fast stain and staining for spores.
6. Study of mutation by Ames test.
7. Assay of antibiotics and demonstration of antibiotic resistance.
8. Analysis of water for potability and determination of MPN.
9. Biochemical characterisation of selected microbes.

### REFERENCE BOOKS

1. General Microbiology, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter, P.R. the MacMillan Press Ltd.
2. Brock Biology of Microorganism, M.T., Martinko, J.M. and Parker, J. Prentice Hall.
3. Microbiology, Pelzer, M.J., Chan, E.C.S. and Kreig, N.R. Tata McGraw Hill.
4. Microbial Genetics, Maloy, S.R., Cronan, J.E. Jr and Freifelder, D. Jones, Bartlett Pub.
5. Microbiology- A laboratory Manual, Cappuccino, J.G. and Sherman, N. Addison Wesley.
6. Microbiological Application, (A laboratory Manual in general Microbiology) Benson, H.J. WCB: Wm C. Brown Publishers.

U.S. Davilan    haz    dble    Ay

**SEMESTER - I BIOTECHNOLOGY PRACTICAL EXAMINATION - II**

(6 hrs. )

**Based on theory Papers 103 & 104****Max. Marks - 50**


---

1.	Microbiological Exercise - 1	.....	4 Marks
2.	Microbiological Exercise - 2	.....	4 Marks
3.	Microbiological Exercise - 3	.....	4 Marks
4.	Microbiological Exercise - 4	.....	4 Marks
5.	Microbiological Exercise - 4	.....	4 Marks
6.	Reproductive Endocrinology Exercise - 1	.....	5 Marks
7.	Reproductive Endocrinology Exercise - 2	.....	5 Marks
8.	Spots based on Endocrinology	.....	10 Marks
9.	Viva - Voce	.....	5 Marks
10.	Practical Record	.....	5 Marks

---

**Total Marks - 50**

Mr. Parilau  
 [Signature]  
 [Signature]

**201. Enzyme technology**

**UNIT-1**

1. Enzyme: Enzyme classification & Nomenclature, EC number
2. Mechanism of enzyme catalysis: Acid-Base catalysis, Covalent catalysis
3. Mechanism of enzyme catalysis: Metal ion catalysis, Electrostatic catalysis
4. Enzymes: Active sites, Substrate specificity

**UNIT-2**

1. Enzyme Kinetics: The Michaelis-Menten equation
2. Analysis of Kinetic data (Determination of  $V_{max}$ , Lineweaver-Burk plot)
3. Enzyme Inhibition: Reversible Inhibition, Irreversible Inhibition
4. Allosteric Regulation

**UNIT-3**

1. Enzyme Purification; Ion-exchange chromatography, Gel filtration chromatography, Affinity chromatography
2. Enzyme Assay: Spectrophotometric method, ELISA method
3. Characterization of purified enzymes: X-ray crystallography, Mass Spectroscopy
4. Enzyme extraction & Fractionation

**UNIT-4**

1. Enzyme in medical diagnosis
2. Enzyme therapy
3. Enzyme disorders in human diseases.
4. Enzyme based sensors

**UNIT-5**

1. Enzyme stability
2. Enzyme Immobilization: - Techniques of immobilization, experimental procedures of immobilization
3. Effect of immobilization on enzyme activity.
4. Industrial Application of immobilized enzyme

U. Ravula      W.B.      J.S.      O.J.

PRACTICAL EXERCISES:

1. Protein estimation methods : Lowry, Bradford and Spectrophotometric.
2. Urease estimation in plant tissues.
3. Assay of acid phosphatase .
4. Assay of Alkaline phosphatase .
5. Determination of optimum pH, .
6. Determination of Km value .
7. assay of enzyme activity and Acetylcholinesterase estimation
8. Enzyme purification : Ammonium sulphate precipitation, Ion exchange chromatography ,Molecular sieve chromatography .
9. Checking of purity of enzyme by chromatography .
10. Molecular Weight determination of enzyme by electrophoresis
11. Sub- cellular fractionation of enzymes and assays

REFERENCE BOOKS

1. The nature of Enzymology by R.L. Foster.
2. Enzymes by Dixon and Webb.
3. Fundamental of Enzymology by Pric and Stevens.
4. Enzyme Catalysis and Regulation by Hammes.
5. Enzyme Reaction Mechanism by Walsch.
6. The Enzyme vol. I & II by Boyer.
7. Enzyme Structure and Mechanism by Alan Fersht.
8. Enzyme Assays: A Practical Approach by Eisenthal and Danson.
9. Enzyme Biotechnology G.Tripathi.
10. Practical Biochemistry by Plummer.
11. Practical Biochemistry by Sawhney and R. Singh.
12. Biotechnology – A new industrial revolution by steve prentis

Mr. Anil Kumar  
Dr. Anil Kumar



202. ENVIRONMENTAL BIOTECHNOLOGY

**UNIT – 1**

- 1. Basic Concepts of Environment
- 2. Natural resources and their conservation .
- 3. Biogeochemical cycle- Gaseous cycle ( Carbon and Nitrogen )
- 4. Biogeochemical cycle- sedimentary cycle ( Phosphorous and Sulphur

**UNIT – 2**

- 1. Environmental Pollution.
- 2. Methods for measurement of pollution.
- 3. Energy flow in Ecosystems .
- 4. Bioindicator of aquatic pollution

**UNIT – 3 .**

- 1. Waste water treatment technology.
- 2. Recycling of Organic waste for fish culture
- 3. Water pollution.
- 4. Radiation ecology

**UNIT – 4**

- 1. Biofertilizer. .
- 2. Noise pollution
- 3. Global environmental problem Ozone depletion, Green House effect, acid rain
- 4. Air Pollution.

**UNIT – 5**

- 1. Application of Hormone biotechnology in Fish culture.
- 2. Transgenic fish.
- 3. Cryopreservation
- 4. Biodiversity and its conservation.

**PRACTICAL EXERCISES:**

1. Determination of pH in the given water sample
2. Determination of D.O in the given water sample
3. Determination of Cl in the given water sample
4. Determination of BOD in the given water sample
5. Determination of Hardness in the given water sample
6. Determination of CO<sub>2</sub> in the given water sample

**REFERENCE BOOKS**

1. Environmental Biotechnology by Dr. Hans Soachim Jordning, Prof. Dr. Joseph Winter
2. Environmental Biotechnology by Lawrence K. Wang, Joo-Haw Tay, Volodymyr
3. Environmental Biotechnology by Geetha Bali
4. Environmental Biotechnology by Arvind Kumar
5. Environmental Biotechnology: Theory & Application By Evans, Greeth M., Furlong, Judith C.
6. Environmental Biotechnology: Advancement in water & waste water: By Z.Ujang, M. Henze
7. Text book of Environmental Biotechnology: by Vinod Soni, Vinay Sharma
8. Environmental Biotechnology: Principal & Applications By Bruce Rittmann & Perry McCarty
9. Environmental Biotechnology: Concept & Application By Soachim Jordning, Prof. Dr. Joseph Winter

Ms. Anil Kumar  
HKB

Lokesh  
Osh

**SEMESTER - II BIOTECHNOLOGY PRACTICAL EXAMINATION - I**

(6 hrs. )

**Based on theory Papers 201 & 202**

Max. Marks - 50

---

1.	Enzymology Exercise - 1 .....	8 Marks
2.	Enzymology Exercise - 2 .....	6 Marks
3.	Enzymology Exercise - 3 .....	6 Marks
4.	Environment Exercise -1 .....	6 Marks
5.	Environment Exercise -2 .....	6 Marks
6.	Spots based on Environment .....	8 Marks
7.	Viva - Voce .....	5 Marks
8.	Practical Record .....	5 Marks

---

**Total Marks - 50**

---

W. Banikar

KSB

KSB

Ouf

Semester – 2 Paper -3  
203. Biomolecules & Metabolism

**Unit 1.**

1. Protein Purifications: Chromatography and electrophoretic separation of proteins, differential centrifugation and ultracentrifugation techniques for proteins separation.
2. Primary structure determination of proteins: sequencing and detection of sequenced proteins.
3. Secondary structure of proteins: alpha helix and beta sheet structures, turns and loops.
4. Tertiary and quaternary structures of proteins: supersecondary structures, domains, peptide symmetry.

**Unit 2.**

1. Fractionation and isolation of nucleic acids.
2. DNA and RNA (t-RNA, m-RNA, r-RNA) structures, geometry of DNA.
3. Biosynthesis of purine ribonucleotides, regulation of purine ribonucleotide synthesis, salvage of purines, synthesis of purine deoxy-ribonucleotides.
4. Biosynthesis of pyrimidine, regulation of pyrimidine biosynthesis, synthesis of pyrimidine deoxy-ribonucleotides.

**Unit 3.**

1. DNA methylation, DNA synthesis.
2. Transcription factors, importance of transcription factors in gene expression.
3. DNA denaturation, renaturation and DNA damage.
4. DNA repair: base excision repair, nucleotide excision repair, mismatch repair, error-pron repair.

**Unit 4**

1. Carbohydrate metabolism: Pathways of glycolysis and tricarboxylic acid cycle.
2. Energy metabolism: Respiratory chain complexes, electron transport and oxidative phosphorylation.
3. Energy rich bonds: High energy compounds, coupled reactions involving ATP
4. Lipid metabolism: Pathways of Beta-oxidation of fatty acids

**Unit 5**

1. Membrane structures, membrane skeleton.
2. Membrane proteins. integral membrane proteins, lipid-linked membranes
3. Miscles and liposomes, lipid mobility, lipid bilayer fluidity.
4. Transport through membranes, Passive mediated transport. active transport

*M. Chandan* *1/10/20* *1/10/20*

## Practical

1a

1. Preparation of Standard curve of proteins, carbohydrate and lipids.
2. Estimation of total proteins, carbohydrates and lipids.
3. Estimation of nucleic acids.
4. Differential centrifugation and fractionation of subcellular organelles.
5. Assay of enzymes activity and determination of enzyme kinetics.
6. Fractionation of mitochondria and determination of ATPase activity in mitochondria.
7. Paper chromatography, thin layer chromatography, separation of amino acids, lipids and phospholipids.
8. Electrophoresis, separation of proteins.
9. Validation of Beer's Lambert Law
10. Determination of Absorption maxima

## Reference Books

1. Fundamentals of Biochemistry 3<sup>rd</sup> edition by D. Voet, JG Voet, CW. Pratt, John Wiley & Sons
2. Principles of Biochemistry 5<sup>th</sup> edition by Nelson, Cox and Lehinger, WH Freeman & Company
3. Molecular Cell Biology by Lodish, Berk, Kaiser, Kreiger, Scott, Zipursky, Darnell
4. Biochemistry with clinical correlations by TJ Devlin, Wiley Leiss
5. Biochemistry by Zubey, Macmilan Publishing Company, New York
6. Biochemistry by CK Mathews, KE Van Holde, The Benjamin Cummings Publishing Company, Melano Park.

MSBansal hsb

Salu Ouf

**204. BIOINSTRUMENTATION****UNIT – 1**

1. Centrifugation : Principal, techniques, preparative ultracentrifugation and analytical ultracentrifugation, Sedimentation coefficient and factors affecting sedimentation coefficient.
2. Application of Centrifugation.
3. Photometry: Basic principal of colorimetry, UV- visible spectrophotometry and IR- spectrophotometry.
4. Atomic absorption spectroscopy : Principles, instrumentation and applications.

**UNIT – 2**

1. Theory, Principle and applications of paper and TLC
2. Gel filtration and Ion exchange chromatography .
3. Affinity chromatography and HPCL.
4. Gas-liquid chromatography .

**UNIT – 3**

1. Electrophoresis : Principal and Theory
2. Paper electrophoresis, starch gel , agarose, PAGE – types, 2D-E.
3. Isoelectric focussing , Immunodiffusion, Immunoelectrophoresis .
4. Southern, Northern and Western Blotting.

**UNIT – 4**

1. Fluorescence spectroscopy: Principals, instrumentation and applications.
2. Nephelometry & Turbidometry.
3. NMR, Principles, instrumentation and applications.
4. X-ray crystallography : Principles, instrumentation and applications.

**UNIT – 5**

1. Microtomy, types, principals and applications.
2. Microscopy : Light, Phase contrast , fluorescence and electron microscopies.
3. Radioactivity Liquid, Scintillation Counter, solid Scintillation counters, .
4. RIA and Autoradiography: Principles and applications.

MSBansal hsb

Dr. A. K. Singh

**PRACTICAL EXERCISES:**

1. Verification Beer's Law
2. Determination of absorption maxima
3. Electrophoresis of Proteins – native and under denaturing conditions.
4. Aminoacid and carbohydrate separation by paper & thin layer chromatography.
5. Gas chromatography
6. Ion exchange and gel filtration chromatography.
7. Separation of sub-cellular organelles by differential centrifugation
8. Separation of blood cells by density gradient centrifugation.

**REFERENCE BOOKS**

1. Physical Biochemistry : Applications to Biochemistry and **molecular Biology by freifelder**
2. Biochemical techniques : Theory and Practice by Robyet and White
3. Principals of Instrumental Analysis by Skoog and West.
4. Analytical Biochemistry by Holme and Peck
5. Biological Spectroscopy by Campbell and Dwek
6. Organic Spectroscopy by Kemp
7. A Biologist's Guide to principles and Techniques of practical Biochemistry by Willson and Goulding.
8. Principles of Instrumental Analysis by Skoog , Hollar And Nicman.



**SEMESTER - II BIOTECHNOLOGY PRACTICAL EXAMINATION - II**

(6 hrs. )

**Based on theory Papers 203 & 204**

Max. Marks - 50

---

1.	Biochemical Exercise - 1 .....	4 Marks
2.	Biochemical Exercise - 2 .....	6 Marks
3.	Biochemical Exercise - 3 .....	5 Marks
4.	Biochemical Exercise -4 .....	5 Marks
5.	Bioinstrumentation Exercise - 1 .....	4 Marks
6.	Bioinstrumentation Exercise - 2 .....	4 Marks.
7.	Bioinstrumentation Exercise - 3 .....	6 Marks
8.	Bioinstrumentation Exercise - 4 .....	6 Marks
9.	Viva – Voce .....	5 Marks
10.	Practical Record .....	5 Marks

---

**Total Marks - 50**

---

U.S. Sankar *U.S.S.*      *U.S.S.*      *U.S.S.*

**301. Genetic Engineering****Unit – 1**

1. Restriction endonucleases
2. Cloning vectors
3. Gene cloning strategies
4. Method of gene transfer in Prokaryotic and Eukaryotic cells.

**Unit – 2**

1. DNA sequencing
2. Site directed Mutagenesis
3. Gene libraries.
4. Gene Expression Analysis.

**Unit-3**

1. Gene therapy for Genetic disorders.
2. Molecular Diagnosis of Genetic Diseases.
3. Gene Silencing
4. Bio safety Measures and Regulations for Genetically Engineered Products.

**Unit-4**

1. Methods of Primer designing and Gene construction.
2. PCR and DNA Amplification.
3. Principle and application of southern, northern and western blotting and Autoradiography.
4. Restriction fragment length polymorphism (RFLP) and DNA fingerprinting.

**Unit-5**

1. Principle of Bioinformatics.
2. Biological database.
3. Ethical Issues in Biotechnology
4. Patenting Biotechnological Products.

M. Saitan hsb

hob Ouf

**PRACTICAL EXERCISES:-**

1. Bacterial Culture and Preparation of competent cells
2. Isolation of plasmid DNA
3. Quantitation of nucleic acids
4. Restriction mapping of plasmid DNA
5. Preparation of single stranded DNA template
6. Gene expression in E. coli and analysis of gene product
7. Transfection.
8. Purification & Quantitation of RNA.
9. Protein Analysis
10. Restriction Mapping
11. Bacterial Transformation.
12. Recombinant Protein Purification and Analysis.
13. Plasmid DNA preparation, Restriction Enzyme Digestion and cloning.

**REFERENCE BOOKS :-**

1. Recombinant DNA – By Watson et al
2. Principles of Gene Manipulation, old and Primrose
3. Gene Cloning: An introduction, Brown
4. Biotechnology : Theory and Techniques ( Vol I & II, 1995), Chirikjian
5. Molecular Genetics of Bacteria, Dale
6. Molecular Cloning ( Vol I, II & III, 2001), Sambrook & Russell
7. Applied Molecular Genetics ( 1999), Miesfeld
8. Genes and Genome (1991) , Singer & Berg
9. Molecular Biotechnology , Glick & Pasternak
10. Plant Molecular Biology (vol. I & II, 2002 ), Glimartin & Bowler
11. Principles of Gene Manipulation and Genomics- Primrose and Twyman .
12. Concept of Genetics – William S. Klug, Michal R. Commings.
13. Molecular Biotechnology – Bernarl R. Glick , Jack j. Pasternak.
14. Genome – T.A. Brown
15. Biotechnology – A laboratory Course- Jeffrey M. Beckes, Guy A. Caldwell, Eue Ann Zachgo

*Note* : All text books are of latest editions:

W. S. K. L. H. B.

J. S. K. O. H. B.

**Semester- 3, Paper -2**  
**Bioprocess Engineering and Bioinformatics**

**Unit-1**

- 1- Isolation, screening and maintenance of industrially important microbes.
- 2- Strain improvement for increased yield and other desirable characteristics.
- 3- Bioreactor design: types of fermentation and fermenters.
- 4- Fermentation media, large scale animal and plant cell cultivation.

**Unit-2**

- 1- Filtration, centrifugation, sedimentation and flocculation method of bioseparation of fermentation products.
- 2- Drying, crystallization, storage and packaging of fermentation products.
- 3- Enzymatic bioconversions e.g. starch and sugar conversion process.
- 4- Cheese making by proteases and various other enzyme catalytic action in food processing.

**Unit-3**

- 1- Food ingredients and additives prepared by fermentation and their purification.
- 2- Microbes and their use in pickling, producing colors and flavors.
- 3- Process wastes- whey, molasses, starch substrates and other food wastes for bioconversion to useful products.
- 4- Bacteriocins from lactic acid bacteria, its production and applications in food preservation.

**Unit-4**

- 1- Proteins and nucleic acid databases
- 2- The NCBI publicly available tools.
- 3- The gene bank sequences to the databases, submitting DNA sequences to the databases and database searching.
- 4- Computational tools for DNA sequence analysis.

**Unit-5**

- 1- Sequence alignment, pair wise alignment techniques, multiple sequence alignment.
- 2- Use of CLUSTAL for the multiple sequence alignment.
- 3- Submitting DNA protein sequences to databases.
- 4- Submitting aligned set of sequences updates and internet resources.

Alsekular   

**PRACTICAL EXERCISES :-**

1. Various Immobilization techniques of cells, enzymes, use of alginate for cell Immobilization.
2. Microbial production & downstream processing of an enzyme eg. Amylase.
3. Studying the kinetics of enzymatic reaction
4. Alignment algorithms
5. Sequence based methods of structure prediction
6. Scoring techniques.
7. Sequence sequence scoring
8. Submitting DNA sequence to the database & database searching
9. Sequence alignments : Pair wise alignment techniques, Multiple sequence Alignment
10. Primer designing
11. Searching MEDLINE, pubmed, current contents, Science citation index , electronic journals. grants & funding information

**REFERENCE BOOKS :-**

1. Jackson AT, Bioprocess engineering in Biotechnology, Prentice Hall , Engelwood cliffs, 1991
2. Shuler ML & Kargif, Bioprocess engineering : Basic concepts, 2<sup>nd</sup> edition, prentical Hall, Enngelwood cliffs, 2002
3. Baily JE & Ollis DF, Biochemical engineering fundamentals, 2<sup>nd</sup> edition McGraw Hill Book Co., Newyork, 1986
4. Comprehensive Biotechnology: the principles, Applications & Regulation of Biotechnology in industry Agriculture & Medicine, Vol. 1,2,3,4, Young MM, Reed Elsevier India Priver. Ltd., India 2004
5. David W. Mount Bioinformatics: sequence & genome Analysis 2<sup>nd</sup> edition, CHSL, Press, 2004
6. A. Baxevanis & F.B.F Ouellette, Bioinformatics: A practical guide to the analysis of genes & proteins , 2<sup>nd</sup> edition , John wiley, 2001
7. Jonathan Pevsner, Bioinformatics & functional genomics, 1<sup>st</sup> edition, Wiley Liss, 2003.

*Note* : All text books are of latest editions:

McQuillar      WJB      LBJ      OJ

27

**SCHEME OF PRACTICAL EXAMINATION**

**M.Sc. ( III<sup>rd</sup> Semester) BIOTECHNOLOGY**

**Based on theory Papers 301 & 302**

06 hrs.

---

1. Genetic Engineering Exercise -1	04 Marks
2. Genetic Engineering Exercise -2	04 Marks
3. Genetic Engineering Exercise -3	04 Marks
4. Genetic Engineering Exercise -4	04 Marks
5. Spotting based on Genetic Engineering & Frontiers in Biotech.	08 Marks
6. Frontiers in Biotechnology Exercise -1	05 Marks
7. Frontiers in Biotechnology Exercise -2	05 Marks
8. Frontiers in Biotechnology Exercise -3	05 Marks
9. Viva Voce	05 Marks
10. Practical Record	05 Marks

---

**Total Marks - 50**

---

*U.Sawlan*

Semester - 3 Paper -3

*U.Sawlan* *hsk* *ABK* *QW*

**Unit-1**

1. Microbial strains of industrial importance
2. Microbial production of antibiotics : Penicillin; Streptomycin
3. Microbial production of Vitamins & amino acids ( Vitamin B12 & Glutamic acid)
4. Microbial production of enzymes: Amylase , Protease.

**Unit-2**

1. Microbial production of alcoholic beverages: Distilled alcoholic beverage- Whisky and Brandy, Microbial production of Vinegar
2. Microbial production of organic acids: Citric acid & Acetic acid
3. Microbial production of solvents : Glycerol & Acetone
4. Microbial production of food- SCP

**Unit-3**

1. Bio-transformation : Steroids and pesticides
2. Mushroom cultivation
3. Biofertilizers
4. Immobilization of microbial cell and their applications

**303: Part B: ANIMAL TISSUE CULTURE**

**Unit - 4**

1. Introduction and organization of animal cell and tissue culture laboratory, Primary and established cell line cultures
2. Serum and protein free defined media and their applications, measurement of viability and cytotoxicity
3. Introduction to balanced salt solutions and simple growth medium : ratio of composition of medium , role of CO<sub>2</sub> and supplements
4. Biology and characterization of the cultured cells measurement of parameters of growth.

**Unit- 5**

1. Basic techniques of mammalian cell culture : disaggregation of tissue
2. Scaling up of animal cell culture, Cell synchronization
3. 3-D animal cell culture
4. FISH and applications of animal cell culture

**PRACTICAL EXERCISES :- Part : A**

*Handwritten signature*

*Handwritten signature*



1. Isolation of industrially important micro organisms for microbial processes
2. Microbial production of citric acid using *Aspergillus niger*
3. Production and estimation of Alkaline Protease
4. Biomass SCP from fungi , algae
5. Organic solvent production
6. Bio- transformations
7. Bio – insecticide isolation, purification and assay
8. Bio- fertilizer production
9. Use of alginate for cell immobilization

29

**PRACTICAL EXERCISES :- Part : B**

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and viability
4. Macrophage monolayer from PEC and measurement of phagocytic activity
5. Cell fusion with PEG
6. Primary tissue explantation technique
- 7.

**REFERENCE BOOKS:-**

1. Biochemical Engineering, Abia, S., Humphery, A.E. and millis, N.F. Univ. Tokyo Press, Tokyo.
2. Biochemical Reactors, Atkinson, B., pion Ltd. London.
3. Biochemical Engineering Fundamentals, Baily. J.E. and Ollis, D.F. McGraw- Hill Book Co. New York.
4. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson, A.T., Prentice hall, Englewood Cliffs.
6. Bioprocess Engineering: Basic concept Shuler, M.L. and Kargi, F., Prentice Hall Englewood Cliffs.
7. Principles of fermentation Technology, Stanbury. P.F. and Whitakar, A., Pergmon Press, Oxford.
8. Bioreaction Engineering principles, Nielson, J. and Viladsen, J , Plenum Press.
9. Chemical Engineering, Problems in Biotechnology, Shuler, M.L.(Ed.), AICHE.
10. Biochemical Engineering, Lee, J.M., Prentice Hall Inc.
11. Bioprocess Engineering – Kinetics, Mass Trasport, Reactors and Gene Expression, Veith W.F., John Wiley and Sons, Inc.
12. Culture of animal cells by RI Freshney.
13. Animal Cell culture practical approach John RW Masters.
14. Animal cell culture techniques by Ed. Martin Clynes.
15. Methods in Cell Biology Vol- 57, Animal cell culture methods.
16. Industrial Biotechnology by, A.H. Patel.
17. Fermentation by Casida
18. Animal Cell Culture & Technology. M.Buth

Note : All text books are of latest editions:

Semester – 3 Paper -4

**304. PLANT BIOTECHNOLOGY**

*M. S. Sankar*

*L. S. Sankar*

**Unit - 1**

1. Objectives, roles and landmarks in plant breeding.
2. Special breeding techniques: Mutational breeding and distant hybridization
3. Generation of genetically modified crops for resistance against biotic and abiotic stresses and nutritional quality
4. Introduction to plant cell and tissue culture and its application

**Unit - 2**

1. Tissue culture media preparation, initiation of callus culture and its maintenance.
2. Suspension on culture: Cell synchronization.
3. Organogenesis : Somatic embryogenesis and its applications.
4. Shoot tip culture : Rapid clonal propagation and production of virus free plants

**Unit- 3**

1. Somaclonal variation and its application for plant improvement.
2. Anther culture; Haploid and Diploid and Diploid plant cell production and their applications
3. Protoplast isolation and fusion, selection of hybrid cell and cybrids.
4. Cryopreservation techniques and applications.

**Unit - 4**

1. Plant cloning vectors: TI plasmid and viral vectors ( CaMV based vectors, Gemini viruses, TMV based vectors, Antisense RNA and ribosome technology.
2. Transgenics in crop improvement : Methods for gene transfer field , Chloroplast Transformation , testing and commercialization.
3. Marker assisted selection : Morphological, Biochemical and Molecular markers, advantages and disadvantages.
4. Plant DNA fingerprinting : Hybridization and PCR based markers ( RFLP, RAPD, AFLP etc. )

**Unit -5**

1. Transgenic plant for edible vaccines, Antibodies.
2. Insect resistance, Bt genes, Non-Bt like protease inhibitors, Green House technology.
3. Biosefty regulation of transgenic crops comersiolization of transgenic plants
4. Intellectual property right ( IPR) and protection ( IPP ) , patenting of biological

**PRACTICAL EXERCISES :-**

*Ms Parikh*

*hsk*      *hsk*

*hsk*

1. Preparation of media
2. Surface sterilization.
3. Organ Culture.
4. Callus propagation, organogenesis, transfer of plants to soil.
5. Protoplast isolation and culture.
6. Anther culture, production of haploids.
7. Agrobacterium culture, selection of transformants, receptor gene ( GUS) assays.
8. Genomic DNA isolation from seeds and plant tissues, electrophoretic analysis
9. Restriction digestion of plant genomic DNA
10. Setting up of PCR reactions.

#### REFERENCE BOOKS:-

1. Plant Biotechnology, Springer Verlag, 2000. J. Hammond, P. Mc.Garvey and V. Yusibov(Eds.)
2. Introduction to plant tissue culture by Kalyan Kumar
3. Plant tissue culture by Bhojwani
4. Practical applications of plant molecular biology by Henry et al
5. Principles of plant Biotechnology by Montell SH et al
6. Plant Genome analysis by PM Gresshoff
7. Essentials of plant breeding by Phundan Singh
8. Biotechnology: Theory and Techniques Vol. I & II by Jack Chirkjian
9. Genetic engineering by Sandhya Mitra
10. Plant Molecular Biology Vol I & II by Phillip M Gimartin & Chris Bowler
11. Plant tissue culture by Razdan
12. Agriculture Biotechnology by Purohit.

*Note* : All text books are of latest editions:

Utkarsh Kumar  
hnm  
Lokesh  
Anil

**SCHEME OF PRACTICAL EXAMINATION****M.Sc. (II<sup>nd</sup> Semester) BIOTECHNOLOGY****Based on theory Papers 303 & 304**

06 hrs.

---

1. Industrial Biotechnology Exercise -1	04 Marks
2. Industrial Biotechnology Exercise -2	04 Marks
3. Industrial Biotechnology Exercise -3	04 Marks
4. Industrial Biotechnology Exercise -4	04 Marks
5. Spotting based on Industrial & Plant Biotechnology	08 Marks
6. Plant Biotechnology Exercise -1	05 Marks
7. Plant Biotechnology Exercise -2	05 Marks
8. Plant Biotechnology Exercise -3	05 Marks
9. Viva Voce	05 Marks
10. Practical Record	05 Marks

---

**Total Marks - 50**

---

W.S. Srinivasan     H. S.     A. S.

