CBCS CURRICULUM OF

BIOTECHNOLOGY HONOURS PROGRAMME

ST. XAVIER'S COLLEGE RANCHI

Implemented from
Academic Session 2025-2028

BOARD OF STUDIES

Department of Biotechnology

St. Xavier's College, Ranchi

A meeting of Board of Studies of B.Sc. Biotechnology (Honours / Core) Programme will be held on 06/11/2025 in the Department of Biotechnology of St. Xavier's College, Ranchi, for academic session 2025-28.

The following ~~external~~ members will be present.

Sl. No.	Name	Designation
1	Dr. Manish Kumar	Professor, Dept of Biotechnology, BIT Mesra, Ranchi. (Subject expert)
2	Dr. Ishwari Prasad Gupta	Associate Professor Department of Botany, DSPMU, Ranchi. (Subject expert)
3	Dr. Biplab Sarkar	Principal Scientist ICAR-Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi. (Industry/Institute representative)
4	Dr. Ladly Rani	Assistant professor and Coordinator Biotechnology PG Dept of Botany, Ranchi University, Ranchi. (RU Representative)
5	Dr. Himadri Bose	Alumnus, Dept. of Biotechnology, St. Xavier's College, Ranchi
6	Dr. Sanyukta	Assistant Professor, Head,Deptt. of Biotechnology, St. Xavier's College, Ranchi (Member)
7	Dr. Shiv Shankar Prasad	Assistant Professor, Deptt. of Biotechnology, St. Xavier's College, Ranchi (Member)
8	Dr. Alfred Besra	Assistant Professor, Deptt. of Biotechnology, St. Xavier's College, Ranchi (Member)

06/11/25

Contents

Preamble

Under this system, there will be 14 core course paper (C1 to C14). These are compulsory to be studied by a student to complete the requirement of B.Sc. (Hons.) Biotechnology programme. The students will study two papers per semester in first year, three core papers per semester in the second year and two core papers per semester in third year. The core papers (6 credits each) will comprise of theory (4 credits) and practical (2 credits).

The Discipline specific elective papers (6 credits each) will comprise of theory (4 credits) and practical (2 credits) like the core papers. A particular option of DSE paper will be offered in V and VI semester

a) Following four **Discipline Specific Elective** (DSE) course have been included, two for semester V and two for semester VI

DSE1. - Animal Biotechnology
DSE2. - Plant Biotechnology
DSE3. - Bioinformatics and Biostatistics
DSE4. - Environmental Biotechnology

b) The students will also undertake two **Skill Enhancement courses (SEC)** of two credits each in III and IV semester of second year

SEC1. - Elementary Computer Application Software
SEC2.- Molecular Diagnostics

c) Besides the core and elective courses, there are two ability enhancement compulsory courses AECC-1(English Communication) and AECC-2 (Environmental Science) of two credits each in 1St and 2nd semester

d) **Generic Elective (GE)**: Different generic elective papers will be offered to students of biotechnology from other departments of the college and the students will have the option to choose two generic elective papers each in the first four semesters. The generic elective will be of six credits each. These generic elective papers (6 credits each) will comprise of theory (4 credits) and practical's (2 credits).

In the CBCS system, a credit is unit by which the course work is measured. It determines the number of hours of instruction required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/ field work per week. A minimum of 164 credits are required to obtain degree in B.Sc. (Hons.) Biotechnology.

COURSE STUCTURE FOR UNDERGRADUATE **'HONOURS'** PROGRAMME

Table AI-1: Distribution of 164 Credits [*wherever there is a Practical there will be no tutorial and vice –versa.]

Course Theory + Practical	Papers	Credits Theory + Tutorial	Credits
I. Core Course	**(CC 1 to 14)**		
Theory	14 Papers	14X4=56	84
Practical/Tutorial*	14 Papers	14X2=28	
II. Elective Course (EC)			
A. Discipline Specific Elective	**(DSE1to4)**		
Theory	4 Papers	4X4=16	24
Practical/ Tutorial*	4 Papers	4X2=8	
B. Generic Elective/ Interdisciplinary	**(GE1to4)**		
Theory	8 Papers	8X4=32	48
Practical/ Tutorial*	8 papers	8X2=16	
III. Ability Enhancement Compulsory Courses (AECC)			
1. English/ Hindi Communication	1 Paper	1X2=2	1X2=2
2. Environmental Science	1 Paper	1x2=2	1x2=2
3. Skill Enhancement Course of the Core Course opted	**(SEC 1& 2)** 2 Papers	2X2=4	2X2=4
		Total Credit = 140 + 24 =164	**140 + 24 = 164**

Table AI-1.1: Course structure for B.Sc./ B.A./ B.Com./B.Voc. (Hons. Programme)

Semester	Honours (Core Courses) 14 Papers	Allied (Elective Courses) 8 Papers	Ability Enhancement (Compulsory Courses) 4 Papers	Total Credits
Sem-I	C-1, C-2 (6+6=12 Credits)	GE-1A, GE-1B (6+6=12 Credits)	English Comm./Hindi Comm. (02 Credits)	**26 Credits**
Sem-II	C-3, C-4 (6+6=12 Credits)	GE-2A, GE-2B (06+06=12 Credits)	EVS (02 Credits)	**26 Credits**
Sem-III	C-5, C-6, C-7 (6+6+6=18 Credits)	GE-3A, GE-3B (06 +06=12 Credits)	SEC-1 (02 Credits)	**32 Credits**
Sem-IV	C-8, C-9, C-10 (6+6+6=18 Credits)	GE-4A, GE-4B (06 +06=12 Credits)	SEC-2 (02 Credits)	**32 Credits**
Sem-V	C-11, C-12 (6+6=12 Credits)	DSE-1, DSE-2 (6+6=12 Credits)		**24 Credits**
Sem-VI	C-13, C-14 (6+6=12 Credits)	DSE-3, DSE-4 (6+6=12 Credits)		**24Credits**
				Total = 164 Credits

COURSES OF STUDY *FOR* UNDERGRADUATE
'Biotechnology Hons' PROGRAMME

Table AI-2 Subject Combinations allowed for Hons. Programme (164 Credits)

Honours/Core Subject **CC 14 Papers**	Discipline Specific Elective Subject **DSES 4 Papers**	Skill Enhancement Course **SEC 2 Papers**	Compulsory Course **AECC 1+1=2 Papers**
Biotechnology	Biotechnology Specific	SEC in Biotechnology	Language Communication + EVS

Table AI-2.1 Semester wise Examination Structure for Mid Sem & End Sem Examinations:

Sem	Core Honours, Allied DSE, Compulsory AECC Courses		Examination Structure		
	Code	Papers	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)
I	C1	Biochemistry and Metabolism +**Lab**	15	60	50
	C2	Cell Biology+**Lab**	15	60	
	GE1A	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	GE1B	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	AECC	Language Communication	---	100	---
II	C3	General Microbiology +**Lab**	15	60	50
	C4	Genetics +**Lab**	15	60	
	GE2A	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	GE2B	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	AECC	EVS	---	100	---
III	C5	Plant Physiology I+**Lab**	15	60	75
	C6	Mammalian Physiology +**Lab**	15	60	
	C7	IPR, Bioethics & Biosafety +**Lab**	15	60	
	GE3A	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	GE3B	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	SEC 1	Elementary Computer Application Software +**Lab**	---	100	---
IV	C8	Molecular Biology+**Lab**	15	60	75
	C9	Immunology+**Lab**	15	60	
	C10	Ecology and Environment Management +**Lab**	15	60	
	GE4A	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	GE4B	Refer Table AI-2.3 of the Syllabus of Subject opted	---	100	---
	SEC 2	Molecular Diagnostics	---	100	---
V	C11	Bioanalytical Tools +**Lab**	15	60	50
	C12	Recombinant DNA Technology+**Lab**	15	60	
	DSE 1	Animal Biotechnology	15	60	50
	DSE 2	Plant Biotechnology + **Lab**	15	60	
VI	C13	Bioprocess Technology+**Lab**	15	60	50
	C14	Genomics and Proteomics +**Lab**	15	60	
	DSE 3	Bioinformatics and Biostatistics	15	60	50
	DSE 4	Environmental Biotechnology + **Lab**	15	60	

GE1 & GE2; Any Two Generic Elective Combinations allowed for UG Biotechnology (Hons) Course may be opted from the List given below:

Table AI-2.2: For Student from SCIENCE background All Four Papers of Two Subjects to be opted:

Generic Elective Subject **GE 4 Papers**	Generic Elective Courses for Science Stream (GE will be other than Core Subject opted)			
	Semester I **GE1**	Semester II **GE2**	Semester III **GE3**	Semester IV **GE4**
Physics	Mechanics **+Lab**	Electricity and Magnetism **+Lab**	Thermal & Statistical Physics **+Lab**	Waves and Optics **+Lab**
Chemistry	Atomic Structure, Bonding, General Org Chem & Aliphatic Hydrocarbons **+Lab**	Chemical Energetics, Equilibria & Functional Gp Org Chemistry-I **+Lab**	Chem. of s- and p-block elements, States of matter and Chem. Kinetics **+Lab**	Chem. of d-block elements, Molecules of Life **+Lab**
Mathematics	Differential Calculus and Coordinate Geometry 2D **+T**	Integral Calculus, Vector Calculus & Trigonometry **+T**	Real Analysis-I, Group Theory & Differential Equations **+T**	Real Analysis-II, Complex Variable, Set Theory & Matrices **+T**
Zoology	Animal Diversity **+Lab**	Human Physiology **+Lab**	Food, Nutrition & Health **+Lab**	Environment & Public Health **+Lab**
Botany	Biodiversity**+Lab**	Plant Ecology & Taxonomy**+Lab**	Plant Anatomy & Embryology**+Lab**	Plant Physiology & Metabolism**+Lab**
Geology	Essentials of Geology **+Lab**	Rocks & Minerals **+Lab**	Fossils & their Applications **+Lab**	Earth Resources **+Lab**

SEMESTER I **5 Papers**

Total 100 x 5 = 500 Marks

I. ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

(Credits: Theory-02)

योग्यता संवर्धन अनिवार्य पाठ्यक्रम:

(क्रेडिट: सैद्धान्तिक-02)

HINDI COMMUNICATION

Theory: 30 Lectures

Marks : 100 (ESE 3Hrs) =100	Pass Marks Th ESE = 40

प्रश्न पत्र के लिए निर्देश

छमाही परीक्षा :

*प्रश्नों के दो समूह होंगे। **खण्ड 'A' अनिवार्य** है जिसमें तीन प्रश्न होंगे। **प्रश्न संख्या 1** में दस **अत्यंत लघु उत्तरीय** 1 अंक के प्रश्न होंगे। **प्रश्न संख्या 2 व 3 लघु उत्तरीय** 5 अंक का प्रश्न होगा। **खण्ड 'B'** में छः में से किन्हीं चार 20 अंको के **विवियनिष्ठ / वर्णनात्मक प्रश्नों** के उत्तर देने होंगे।*

नोट : थ्योरी परीक्षा में पूछे गए प्रत्येक प्रश्न में उप-विभाजन हो सकते हैं।

हिन्दी व्याकरण एवं संप्रेषण

सैद्धान्तिक:30व्याख्यान

इकाई–1 **हिन्दी व्याकरण और रचना,**

संज्ञा, सर्वनाम, वि ेशण, क्रिया, अव्यय, कारक, वचन, संधि,उपसर्ग, प्रत्यय तथा समास, लिंग निर्णय, पर्यायवाची भाब्द, विलोम भाब्द, अनेक भाब्दों के लिए एक भाब्द, भाब्द भाुद्धि, वाक्य भाुद्धि, मुहावरे और लोकोक्तियां, पल्लवन एवं संक्षेपण।

इकाई–2 **निबंध कला तथा समसामयिक एवं राष्ट्रीय विषयों पर निबंध लेखन**

इकाई–3 **संप्रेषण (संचार)**

—संप्रेशण की अवधारण और महत्व, संप्रेशण के लिए आव यक भार्तें, संप्रेशण के प्रकार, संप्रेशण का माध्यम, संप्रेशण कला, संप्रेशण की तकनीक, वाचन कला, समाचार वाचन, साक्षात्कार कला,रचनात्मक लेखन का लक्ष्य, रचनात्मक लेखन का आधार, भाव और विचारों की प्रस्तुति, वाक् कला की उपयोगिता।

अनुशंसित पुस्तकें :–

- ☐ वृहत व्याकरण भास्कर : डॉ0 वचनदेव कुमार
- ☐ वृहत निबंध भास्कर : डॉ0 वचनदेव कुमार
- ☐ आधुनिक हिन्दी व्याकरण और रचना : डॉ0 वासुदेव नन्दन प्रसाद
- ☐ रचना मानस : प्रो0 रामेश्वर नाथ तिवारी
- ☐ व्यवहारिक हिन्दी : डॉ0 जंग बहादुर पाण्डेय
- ☐ रचनात्मक लेखन : डॉ0 रमेश गौतम
- ☐ राजहंस हिन्दी निबंध : प्रो0 आर0 एन0 गौड़
- ☐ सफल हिन्दी निबंध : रत्नेश्वर
- ☐ निबंध सहचर : डॉ0 लक्ष्मण प्रसाद
- ☐ उपकार मुहावरे और लोकोक्तियाँ : प्रो0 राजेश्वर प्रसाद चतुर्वेदी
- ☐ कहानियों कहावतों की : प्रताप अनम
- ☐ सम्प्रेषणपरक हिन्दी भाषा शिक्षण : डॉ0 वैश्ना नारंग
- ☐ शैली विज्ञान : डॉ0 सुरेश कुमार
- ☐ शैली विज्ञान प्रतिमान और विश्लेषण : डॉ0 पांडेय शशिभूषण 'शीतांशु'
- ☐ भौली विज्ञान का इतिहास : डॉ0 पांडेय शशिभूषण 'शीतांशु'

OR

ENGLISH COMMUNICATION

Theory: 30 Lectures

Marks: 100 (ESE 3Hrs) =100	Pass Marks Th ESE = 40

Instruction to Question Setter for
End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain three questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2& 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of 20 marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

OBJECTIVE: To equip students effectively to acquire skills in reading, writing, comprehension and communication, as also to use electronic media for English Communication.

Unit I: Communication – Definition, stages, barriers, types: verbal and non-verbal, Listening- Meaning, Nature and importance, Principles of Good Listening.

Unit II: Class-presentation (Oral for five minutes) on any of the above-mentioned topics: Descriptive writing, expansion of an idea.

Unit III: Writing skills –, notice writing, advertisement writing, précis writing, essay writing, letter writing (applications), Business letter formats (letters of enquiry, replies and complaints), resume writing, covering letter

Unit IV: Vocabulary building: One-word substitution, synonyms and antonyms, idioms and phrases

Suggested Reading:

- *Technical Communication*, M.H. Rizvi, Tata McGrawhill
- *Effective Business Communication*, Asha Kaul
- *Developing Communication Skills*, Krishnamohan
- *Functional Grammar and Spoken and Written Communication in English*, Bikram K. Das, Orient Blackswan
- *Precis, Paraphrase and Summary*, P.N. Gopalkrishnan, Authors Press
- *Communication Skills*, Sanjay Kumar and Pushplata, Oxford Publication

Note: Latest edition of text books may be used.

II. GENERIC ELECTIVE (GE 1A): (Credits: 06)

All Four Papers (Refer Table AI 2.2) of any One Subject to be opted other than the Honours Subject. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

III. GENERIC ELECTIVE (GE 1B): (Credits: 06)

All Four Papers (Refer Table AI 2.2) of any One Subject to be opted other than the GE1 & Honours Subject. Refer Table AI 2.2 and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

IV. CORE COURSE –C 1: (Credits: Theory-04, Practicals-02)

Marks: 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

BIOCHEMISTRY AND METABOLISM

Theory: 60 Lectures

UNIT I: Introduction to Biochemistry: **(10 Periods)**
Water: Structure and Properties. Water as a biological Solvent

Carbohydrates: Structure Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

Amino acids & Proteins: Structure& Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces Stabilizing protein structure and shape. Different level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

UNIT: II **(10 Periods)**
Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

UNIT: III **(20 Periods)**
Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, Enzyme Catalysis, Enzyme Inhibition, Enzyme Kinetics. Factor affecting enzyme action, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyper thermophilic archaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes-A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

UNIT: IV **(20 Periods)**
Metabolism: Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids. Transmination, Deamination, Urea Cycle.

Suggested Readings

- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry.VI Edition. W.H Freeman and Co.
- Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
- Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
- Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
- Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

V. CORE COURSE- C 2: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

CELL BIOLOGY Theory: 60 Lectures

UNIT: I **(10 Periods)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT: II **(15 Periods)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT: III **(20 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions
Ribosomes: Structures and function including role in protein synthesis.
Mitochondria: Structure and function, Genomes, biogenesis.
Chloroplasts: Structure and function, genomes, biogenesis
Nucleus: Structure and function, chromosomes and their structure.

UNIT: IV **(15Periods)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix. Cell Signaling: Various Types- Endocrine, Paracrine, Autocrine, Hormone and growth factors. Neurotransmitters, Peptide hormones, Steroid Hormones, Thyroid hormones and signaling pathway. Eiconoides, gases: CO & NO. Cellular responses to environmental signals in plants.
Receptors- Types of cell surface receptors: Basic concept and mechanism of signal transduction: Bacterial and Plant two- component signaling system, G-Protein coupled receptor, Ras, Raf, Plant Hormone action.
Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer. Molecular basis of cancer: Oncogenes, Tumour Supressive Gene.

Suggested Readings

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

BIOTECHNOLOGY PRACTICAL-C 1 & C2 LAB

60 Lectures

Marks: Pr (ESE: 3Hrs) =50 **Pass Marks: Pr (ESE) = 20**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. Preparation of buffers: Acetate and Phosphate Buffer
2. Principles of Colorimetry: Verification of Beer's law, To study relation between absorbance and % transmission.
3. Estimation of Sugar, Protein, and RNA
4. Estimation of blood glucose by glucose oxidase method.
5. Separation of Amino acids by paper chromatography.

Group-B

1. Study of plasmolysis and de-plasmolysis
2. Study of structure of any Prokaryotic and Eukaryotic cell
3. Micrometry: Calibration of Microscope, Measurement of cell size
4. Cell division in onion root tip
5. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions

SEMESTER II — 5 Papers

Total 100 x 5 = 500 Marks

I. ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

(Credits: Theory-02)

Marks : 100 (ESE: 3Hrs)=100	Pass Marks Th ESE = 40

Instruction to Question Setter for

End Semester Examination (ESE):

*There will be **objective type test** consisting of hundred questions of1 mark each. Examinees are required to mark their answer on **OMR Sheet** provided by the University.*

AECC – ENVIRONMENT STUDIES

Theory: 30 Lectures

Unit 1: Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

(2 lectures)

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

  a. Forest ecosystem
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(2 lectures)

Unit 3: Natural Resources: Renewable and Non--renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).
- Energy resources : Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(5 lectures)

Unit 4 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega--biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity : In--situ and Ex--situ conservation of biodiversity.

- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(5 lectures)

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- IPR, Bioethics & Biosafety : Control measures of urban and industrial waste.
- Pollution case studies.

(5 lectures)

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(4 lectures)

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(3 lectures)

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems--pond, river, Delhi Ridge, etc.

(Equal to 4 lectures)

Suggested Readings:

- Raziuddin, M.., Mishra P.K. 2014,*A Handbook of Environmental Studies*, Akanaksha Publications, Ranchi.
- Mukherjee, B. 2011: *Fundamentals of Environmental Biology*. Silverline Publications, Allahabad.
- Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
- Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
- Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
- Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment &Security. Stockholm Env. Institute, Oxford Univ. Press.
- Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.

- Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
- McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
- McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
- Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
- Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
- Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
- Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India. Tripathi 1992.*
- Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
- Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
- Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
- Thapar, V. 1998. *Land of the Tiger: A Natural History of the Indian Subcontinent.*
- Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
- Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.
- World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University

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II. GENERIC ELECTIVE (GE 2A): (Credits: 06)

GE2A paper of First subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

III. GENERIC ELECTIVE (GE 2B): (Credits: 06)

GE2B paper of Second subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

IV. CORE COURSE -C 3: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

GENERAL MICROBIOLOGY Theory: 60 Lectures

UNIT: I (10 Periods)

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, and Protozoa. General Account of viruses: Structure, reproduction and lifecycle: Lambda, M13and TMV.

UNIT: II (10 Periods)

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT: III (20 Periods)

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways

Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT: IV (20 Periods)

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods

Suggested Readings

- Alexopoulos CJ, Mims CW, and Blackwell M.(1996). Introductory Mycology. 4th Ed. J. and Sons, Inc.
- Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
- Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
- Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
- Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book
- Company. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5thedition. McMillan.
- Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th eEd. Pearson Education.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.

V. CORE COURSE -C 4: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

GENETICS Theory: 60 Lectures

UNIT: I (12 Periods)

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, 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, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT: II (18 Periods)

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

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.

UNIT: III **(15 Periods)**

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 inhuman beings, abnormalities– 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 **(15 Periods)**

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage.

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, allelic and genotype frequencies, changes in allelic frequencies.

Suggested Readings

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

BIOTECHNOLOGY PRACTICAL -C 3 & C4 LAB — 60 Lectures

Marks : Pr (ESE: 3Hrs) =50	Pass Marks: Pr (ESE) = 20

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. Preparation of media & sterilization methods
2. Methods of Isolation of bacteria from different sources (air, water and soil)
3. Obtaining pure cultures of Bacteria.
4. Staining methods: simple staining, Gram staining
5. Antibiotics- sensitivity test.
6. Growth Curve of Bacteria. Enumeration of microorganism- total & viable count.

Group-B

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Karyotyping with the help of photographs
5. Study of polyploidy in onion root tip by colchicine treatment.

SEMESTER III — 6 Papers

Total 100 x 6 = 600 Marks

I. SKILL ENHANCEMENT COURSE SEC 1: (Credits: Theory-02)

Marks : 100 (ESE: 3Hrs) =100	Pass Marks Th ESE = 40

Instruction to Question Setter for

End Semester Examination (ESE):

*There will be **objective type test** consisting of hundred questions of 1 mark each. Students are required to mark their answer on **OMR Sheet** provided by the University.*

ELEMENTARY COMPUTER APPLICATION SOFTWARES:

A Common Syllabus Prescribed by Ranchi University **Theory: 30 Lectures**

Objective of the Course

The objective of the course is to generate qualified manpower in the area of Information Technology (IT) and Graphic designing which will enable such person to work seamlessly at any Offices, whether Govt. or Private or for future entrepreneurs in the field of IT.

A. INTRODUCTION TO COMPUTER SYSTEM

Basic Computer Concept

Computer Appreciation - Characteristics of Computers, Input, Output, Storage units, CPU, Computer System. **(1 Lecture)**

Input and Output Devices

Input Devices - Keyboard, Mouse, joystick, Scanner, web cam,
Output Devices- Soft copy devices, monitors, projectors, speakers, Hard copy devices, Printers – Dot matrix, inkjet, laser, Plotters. **(4 lectures)**

Computer Memory and Processors

Memory hierarchy, Processor registers, Cache memory, Primary memory- RAM, ROM, Secondary storage devices, Magnetic tapes, Floppy disks, hard disks, Optical Drives- CD-ROM, DVD-ROM, CD-R, CD-RW, USB Flash drive, Mass storage devices: USB thumb drive. Managing disk Partitions, File System. Basic Processor Architecture, Processor speed, Types of processor.

(5 lectures)

Numbers Systems and Logic Gates

Decimal number system, Binary number system, Octal number system, Hexadecimal number system, Inter-conversion between the number systems. Basic Logic gates-AND, OR, NOT, Universal logic gates- NAND, NOR

(3 lectures)

Computer Software

Computer Software- Relationship between Hardware and Software, System Software, Application Software, Compiler, Names of some high level languages, Free domain software.

(2 Lectures)

Internet & its uses

History of Internet, WWW and Web Browsers: Web Browsing software, Surfing the Internet, Chatting on Internet, Basic of electronic mail, Using Emails, Document handling, Network definition, Common terminologies: LAN, WAN, MAN, Node, Host, Workstation, Bandwidth, Network Components: Severs, Clients, Communication Media. Wireless network

(3 Lectures)

Operating system-Windows

Operating system and basics of Windows, The User Interface, Using Mouse and Moving Icons on the screen, The My Computer Icon, The Recycle Bin, Status Bar, Start and Menu & Menu-selection, Running an Application, Windows Explorer Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows, Windows Setting, Control Panels, Wall paper and Screen Savers, Setting the date and Sound, Concept of menu Using Help, Advanced Windows, Using right Button of the Mouse, Creating Short cuts, Basics of Window Setup, Notepad, Window Accessories

(2 Lectures)

B. MICROSOFT OFFICE 2007 AND LATEST VERSIONS

Word Processing

Word processing concepts: saving, closing, Opening an existing document, Selecting text, Editing text, Finding and replacing text, printing documents, Creating and Printing Merged Documents, Character and Paragraph Formatting, Page Design and Layout. Editing and Checking. Correcting spellings. Handling Graphics, Creating Tables and Charts, Document Templates and Wizards, Mail merge and Macros.

(3 Lectures)

Microsoft Excel (Spreadsheet)

Spreadsheet Concepts, Creating, Saving and Editing a Workbook, Inserting, Deleting Work Sheets, entering data in a cell / formula Copying and Moving from selected cells, handling operators in Formulae, Functions: Mathematical, Logical, statistical, text, financial, Date and Time functions, Using Function Wizard. Formatting a Worksheet: Formatting Cells changing data alignment, changing date, number, character or currency format, changing font, adding borders and colors, Printing worksheets, Charts and Graphs – Creating, Previewing, Modifying Charts. Integrating word processor, spread sheets, web pages. Pivot table, goal seek, Data filter and scenario manager

(4 Lectures)

Microsoft Power Point (Presentation Package)

Creating, Opening and Saving Presentations, Creating the Look of Your Presentation, Working in Different Views, Working with Slides, Adding and Formatting Text, Formatting Paragraphs, Drawing and Working with Objects, Adding Clip Art and other pictures, Designing Slide Shows, Running and Controlling a Slide Show, Printing Presentations. Creating photo album, Rehearse timing and record narration. Master slides. **(3 Lectures)**

Reference Books

- Nishit Mathur, Fundamentals of Computer , Aph publishing corporation(2010)
- Misty E. Vermaat,. Microsoft word 2013 1st Edition (2013).
- Satish Jain, M.Geeta, MS- Office 2010 Training Guide, BPB publication (2010)
- Joan Preppernau, Microsoft PowerPoint 2016 step by step, Microsoft press(2015)
- Douglas E Corner, The Internet Book 4th Edition, prentice –Hall(2009)
- Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)
- Steven welkler, Office 2016 for beginners, Create Space Independent publishing Plateform (2016)

SKILL ENHANCEMENT LAB- SEC 1 LAB

A. MS-WORD LAB ASSIGNMENT

1. Write down the following Paragraph OR any one provided by your teacher;

Without a doubt, the Internet is one of the most important inventions of modern times. The Internet is a global interconnected computer networks which allow each connected computer to share and exchange information with each other. The origins of the Internet can be traced to the creation of Advanced Research Projects Agency Network (ARPANET) as a network of computers under the auspices of the U.S. Department of Defense in 1969.

Apply following effects on The paragraph:

i. Paragraph **font-size** and **font-type** must be 12 Verdana.
ii. Paragraph **alignment** must be justified and double line spacing.
iii. **Highlight** the "(ARPANET)" with green color.
iv. Make the "Internet" keywords **Bold and Italic**.
v. Insert any "**WordArt**" and a **symbol** to your document.
vi. Insert a **clipart** to your document.
vii. Add following lines to your document:
Internet, Intranet, Extranet, URL, WWW, Networking, Protocols, HTTP, TCP/IP

2. Create a Table of following fields:

Name, Surname, Age, Gender, Job and apply the following effects

i. Insert 10 records
ii. Font size should be 12
iii. Title size should be 14
iv. Font type should be Times new Roman
v. Title color should be blue
vi. Text color should be black
vii. Table border should be 2

3. Write a letter on 'Road Safety' and send to 'Multiple Recipients' using mail merge.

4. Type the paragraph given below:

Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/Internet Protocol). Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol. Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/ Internet Protocol). Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol.

Apply the following:

i. Change Internet into Internets at a time
ii. Heilight TCP/IP in red color
iii. Replace protocol into protocols
iv. Find the word "Public"

B. MICROSOFT EXCEL LAB ASSİGNMENT

Basic Formatting and Spreadsheet Manipulation

1. Add rows and columns to an existing spreadsheet
2. Reformat data (center, comma and currency styles, bold, text color)
3. Work with a simple formula (product) and function (sum)

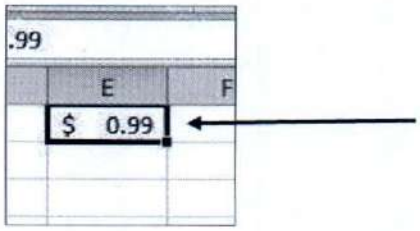
Assignment

1. Create a workbook as shown below.
2. To enter new rows or columns, simply click on the row or column header to select the whole row or column. Then right click with the mouse and choose insert.
3. Add the new row for S Spade with the data that's shown below (between the original rows 7 and 8).
4. Add a column for gender and the data as shown below (between the original columns A and B). Enter the appropriate gender for yourself in the last row.

A	B	C	D
Name	**Male/Female**	**Genre**	**Number of Songs**
J Smith	F	Blues	50
B Doe	M	Country	110
S Spade	F	Country	200
F Zappa	M	Blues	1400
F Zappa	M	Alternative	2300
J Smith	F	Alternative	150
S Spade	F	Blues	1000
B Doe	M	Blues	75
yourname	M	Blues	800

5. Center the data in columns B and C. Do this by selecting the whole column and click the center icon on the ribbon.
6. Bold the data in row 1, the column headings (ensure that the data all remains visible within the column boundaries).
7. Change the font color for row 1 to Blue.
8. Change the format of the data in column D to comma style (no decimal places showing).There is an icon on the home tab that sets it to comma style easily.
9. Add two new column labels to the right of the current columns; **Unit Price** and **Total Cost**. (They will be in columns E and F.) These two columns of data should be currency type so that the dollar sign is shown. There is an icon to quickly format the selected column as currency type.
10. All tunes are $.99, so enter that value for all rows in Column E. You can copy quickly by using the **Auto Fill** handle and drag that amount down. When you over your mouse over the tiny square in

the bottom right hand corner of the active cell, your mouse shape will become a skinny plus sign, and you can click and drag that cell to make a copy.



11. Calculate Total Cost (column F) as *column D times Column E.* You will type in a formula like this into cell F2: **=D2*E2** (Be sure to begin the formula with an equal sign)
12. Use the AutoFill (skinny plus sign) again to copy the formula down column F; down to F10. Double check the picture below to make sure yours has the correct values
13. Add a border to all of the cells (A1-f10) using the Borders tool in the Fonts group on the Home Tab.
14. Change the page layout to landscape. Do this by clicking the Page Layout tab on the ribbon and then to Orientation to Landscape.
15. Save the file.
16. Click in cell F11 and Use the sum function or the shortcut icon that looks like ∑ to get the total of the Total Cost column.
17. Ensure that the data is all visible within the column boundaries. Make the columns wider if needed.
18. Save the workbook. Your final spreadsheet should look like the following when printed.

Name	Male/Female	Genre	Number of Songs	Unit Price	Total Cost
J Smith	F	Blues	50	$ 0.99	$ 49.50
B Doe	M	Country	110	$ 0.99	$ 108.90
S Spade	F	Country	200	$ 0.99	$ 198.00
F Zappa	M	Blues	1,400	$ 0.99	$ 1,386.00
F Zappa	M	Alternative	2,300	$ 0.99	$ 2,277.00
S Spade	F	Blues	1,000	$ 0.99	$ 990.00
J Smith	F	Alternative	150	$ 0.99	$ 148.50
B Doe	M	Blues	75	$ 0.99	$ 74.25
yourname	M	Blues	800	$ 0.99	$ 792.00
					$ 6,024.15

Create a sample table given below in Excel

- Using formula find Total
- Find the maximum value using MAX function from the **Units** column
- Find minimum value from **Total** column

Order Date	Region	Rep	Item	Units	Unit Cost	Total
1/6/2016	East	Jones	Pencil	95	1.99	189.05
1/23/2016	Central	Kivell	Binder	50	19.99	999.50
2/9/2016	Central	Jardine	Pencil	36	4.99	179.64
2/26/2016	Central	Gill	Pen	27	19.99	539.73
3/15/2016	West	Sorvino	Pencil	56	2.99	167.44
4/1/2016	East	Jones	Binder	60	4.99	299.40
4/18/2016	Central	Andrews	Pencil	75	1.99	149.25
5/5/2016	Central	Jardine	Pencil	90	4.99	449.10
5/22/2016	West	Thompson	Pencil	32	1.99	63.68
6/8/2016	East	Jones	Binder	60	8.99	539.40
6/25/2016	Central	Morgan	Pencil	90	4.99	449.10
7/12/2016	East	Howard	Binder	29	1.99	57.71
7/29/2016	East	Parent	Binder	81	19.99	1,619.19
8/15/2016	East	Jones	Pencil	35	4.99	174.65
9/1/2016	Central	Smith	Desk	2	125.00	250.00
9/18/2016	East	Jones	Pen Set	16	15.99	255.84
10/5/2016	Central	Morgan	Binder	28	8.99	251.72
10/22/2016	East	Jones	Pen	64	8.99	575.36
11/8/2016	East	Parent	Pen	15	19.99	299.85
11/25/2016	Central	Kivell	Pen Set	96	4.99	479.04
12/12/2016	Central	Smith	Pencil	67	1.29	86.43
12/29/2016	East	Parent	Pen Set	74	15.99	1,183.26

C. MS-POWERPOINT LAB ASSIGNMENT

Activity 1 : Using Text & Background/Themes

i. Create one new slide and insert any text.
ii. To make your slide more attractive, use the themes or background.
iii. Make sure it apply for every slide not only one slide.

Activity 2 : Apply Custom Animation On Text

i. Use the custom animation to add effects on your text. Set the text move after you click the mouse.
ii. If you have more than one text, add effects for each of text.

Activity 3 : Insert Image & WordArt

i. Insert one new blank slide.
ii. Choose one pictures or clip art from any source and insert in your new slide.
iii. Using the WordArt, make a note or title on your picture.
iv. Use the custom animation again to add effects on your picture and WordArt.

Activity 4 : Insert Text Box

i. Insert one new blank slide.
ii. Use the text box to insert one paragraph of text and adjust your text.

Activity 5 : Insert Smart Art

i. Insert one new blank slide.
ii. Insert the Smart Art and put your text on the Smart Art.

Activity 6 : Insert Audio

i. Back to your first slide and insert one audio on that slide. The audio must play automatically when you show your slide.
ii. Make sure the speaker also not appear when you show your slide. (the icon).
iii. The audio must play when you show alls your slide, not only one slide.

Activity 7 : inserting Video

i. Insert one new slide and insert one short video

Activity 8 : Save File

i. Save your file

Activity 9 : Create Photo Album & Hyperlink

i. Insert one new slide and put a text ex: "My Photo Album"
ii. Create one photo album and adjust your text and your photos
iii. Save your photo album with a new file
iv. Make a hyperlink to your photo using the text "My Photo Album"

Reference Books:

- Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)
- steven welkler, Office 2016 for bignners, Create Space Independent publishing plateform(2016)
- Elaine Marmel, office 2016 simplified, 1st Edition, John wiley and sons Inc(2016)
- Patrice-Anne Rutledge, Easy office 2016 1st edition, Que publishing(2016)

II. GENERIC ELECTIVE (GE 3A): (Credits: 06)

GE3A paper of First subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

III. GENERIC ELECTIVE (GE 3B): (Credits: 06)

GE3B paper of Second subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

IV. CORE COURSE -C 5: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

PLANT PHYSIOLOGY Theory: 60 Lectures

UNIT: I (12 Periods)

Plant water relations and micro & macro nutrients

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

UNIT: II (20 Periods)

Carbon Metabolism

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point

UNIT: III

Nitrogen Metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT: IV (18 Periods)

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene)

Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization

Suggested Readings:

- Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
- Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
- Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
- Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
- Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
- Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4thedition, W.H. Freeman and Company, New York, USA.
- Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
- Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4thedition, Sinauer Associates Inc . MA,USA

V. CORE COURSE -C 6: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

MAMMALIAN PHYSIOLOGY Theory: 60 Lectures

UNIT: I (15 Periods)

Digestion and Respiration Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. BMR

Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT: II (15 Periods)

Circulation

Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.

Mechanism of working of heart: Cardiac cycle, ECG

UNIT: III (15 Periods)

Muscle physiology and osmoregulation

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT: IV (15 Periods)

Nervous and endocrine coordination

Mechanism of generation & propagation of nerve impulse, structure of synapse, synapticconduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids).

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. Basic mechanism of action.

Suggested Readings

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition.Hercourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.

VI. CORE COURSE -C 7: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

IPR, BIOETHICS & BIOSAFETY Theory: 60 Lectures

UNIT: I (15 Periods)

Biotechnology intellectual property rights. Patents, Trade secret, copyright, Trademark, Plant Breeder's Right and farmer Right (PPVFR)

UNIT: II (20 Periods)

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

UNIT: III (10 Periods)

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.

UNIT: IV (15 Periods)

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Suggested Readings

- Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
- Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publisher

BIOTECHNOLOGY PRACTICAL -C5, C6 & C7 LAB — 60 Lectures

Marks : Pr (ESE: 3Hrs) =75	Pass Marks: Pr (ESE) = 30

Instruction to Question Setter for
End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 45 marks*
Practical record notebook	*= 15 marks*
Viva-voce	*= 15 marks*

Group-A

1. Demonstration of plasmolysis by *Tradescantia* leaf peel.
2. Demonstration of opening & closing of stomata
3. Demonstration of guttation on leaf tips of grass and garden nasturtium.
4. Separation of photosynthetic pigments by paper chromatography
5. Preparation of root nodules from a leguminous plant.

Group-B

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Determination of TLC
4. Determination of Haemoglobin

Group-C

1. Proxy filing of Indian Product patent
2. Planning of establishing a hypothetical biotechnology industry in India
3. A case study on clinical trials of drugs in India with emphasis on ethical issues.
4. Case study on women health ethics.
5. Case study on medical errors and negligence.
6. Case study on handling and disposal of radioactive waste

SEMESTER IV — 6 Papers

Total 100 x 6 = 600 Marks

I. SKILL ENHANCEMENT COURSE SEC 2: (Credits: Theory-02)

Marks : 100 (ESE 3Hrs) =100	Pass Marks Th ESE = 40

Instruction to Question Setter for

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain three questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of 20 marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

MOLECULAR DIAGNOSTICS — 30 Lectures

UNIT: (15 Periods)

Enzyme Immunoassays:

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immunohistochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

UNIT: II (15 Periods)

Molecular methods in clinical microbiology:

Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

Laboratory tests in chemotherapy:

Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

UNIT: III (18 Periods)

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

UNIT: IV (12 Periods)

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. Transgenic animals.

Suggested Readings:

- Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
- Bioinstrumentation, Webster
- Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
- Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
- Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology.24th edition. McGraw Hill Publication.
- Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
- Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology.19th edition. Appleton-Centuary-Crofts publication.
- Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.
- Microscopic Techniques in Biotechnology, Michael Hoppert

II. GENERIC ELECTIVE (GE 4A): (Credits: 06)

GE4A paper of First subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

III. GENERIC ELECTIVE (GE 4B): (Credits: 06)

GE4B paper of Second subject selected in Sem-I to be studied. Refer Table AI 2.2 for name of papers and for Content in detail refer the Syllabus of Opted Generic Elective Subject.

IV. CORE COURSE -C 8: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

MOLECULAR BIOLOGY **Theory: 60 Lectures**

UNIT: I **(15 Periods)**

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 **(10 Periods)**

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

UNIT: III **(17 Periods)**

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 **(18 Periods)**

Regulation of gene expression and translation
Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), 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.

Suggested Readings

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Ed. J. Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- 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.
- 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.

V. CORE COURSE -C 9: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for
Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

IMMUNOLOGY Theory: 60 Lectures

UNIT: I **(20 Periods)**
Immune Response - An overview, cells and organs of immune system, Haematopoiesis molecular structure of Immuno-globulins or Antibodies, Humoral& Cellular immune responses, B-lymphocytes, T-lymphocytes& immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, Basic concept of Plant Immunity.

UNIT: II **(15 Periods)**
Genome rearrangement during B- lymphocyte differentiate Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription.

UNIT: III **(13 Periods)**
Antigens- factors affecting antigenicity, Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms (Bacterial and viral).Autoimmune diseases, Immunodeficiency-AIDS.

UNIT: IV **(12 Periods)**
Hypersensitivity, compliment system, ADCC, Opsonization, effector mechanism, 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.

Suggested Readings

- Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
- Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
- Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
- Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
- Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
- Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
- Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
- Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA

VI. CORE COURSE -C 10: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75 **Pass Marks: Th (MSE +ESE) = 30**

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type**three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

ECOLOGY AND ENVIRONMENT MANAGEMENT Theory: 60 Lectures

UNIT-I

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.

UNIT II

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Tropic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochernical cycles (N,C,P cycles).

UNIT-III

Pollution & environmental Health related to Soil. Water. Air. Food, Pesticides, Metals, Solvents, Radiations, Carcinogen, Poisons. Detection of Environmental pollutant, Indicators & detection systems. Bin-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup Case studies

UNIT-IV

Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal

Suggested Readings:

- Holt DH. Entrepreneurship: New Venture Creation.
- Kaplan JM Patterns of Entrepreneurship.
- Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

BIOTECHNOLOGY PRACTICAL -C8, C9 & C10 LAB — 60 Lectures

Marks : Pr (ESE: 3Hrs) =75	Pass Marks: Pr (ESE) = 30

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 45 marks*
Practical record notebook	*= 15 marks*
Viva-voce	*= 15 marks*

Group-A

1. Preparation of reagents for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA.
5. Demonstration of AMES test.

Group-B

1. Differential leucocytes count
2. Heamagglutination assay
3. Separation of serum from blood
4. Double immunodiffusion test using specific antibody and antigen.
5. ELISA

Group-C

1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
2. Determination of population density in a terrestrial community or hypothetical community by quad rate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.
3. Principle of CPS (Global Positioning System)
4. Study of the **life** table and fecundity table, **plotting of the** three types of survivorship curves from the hypothetical data.
5. Study of the types **of sail,** their texture by sieve **method** and rapid **tests for —pH,** chlorides, nitrates, carbonates and organic carbon
6. Study **any five** endangered/ **threatened species- one** from each class.

SEMESTER V — 4 Papers

Total 100 x 4 = 400 Marks

III. BIOTECHNOLOGY SPECIFIC (DSE 1):

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*
***Note:** There may be subdivisions in each question asked in Theory Examinations.*

ANIMAL BIOTECHNOLOGY — Theory: 60 Lectures

UNIT: I **(10 Periods)**

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

UNIT: II **(10 Periods)**

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 **(20 Periods)**

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

UNIT: IV **(20 Periods)**

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

Suggested Readings:

- Brown, T.A.(1998). Molecular biology Labfax II: Gene analysis. II Ed.Academic Press, California, USA.
- Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
- Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition.ASM press, Washington, USA.
- 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.
- 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.

IV. BIOTECHNOLOGY SPECIFIC (DSE 2): (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

PLANT BIOTECHNOLOGY Theory: 60 Lectures

UNIT: I (15 Periods)

Introduction, Cryo and organogenic differentiation, Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT: II (20 Periods)

In vitro haploid production Androgenic methods: Anther culture, Microspore culture and oogenesis Significance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT: III (15 Periods)

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Somaclonal variation Nomenclautre, methods, applications basis and disadvantages.

UNIT: IV (10 Periods)

Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

Suggested Readings:

- Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
- Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
- Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
- Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
- Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
- Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
- Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
- Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

BIOTECHNOLOGY PRACTICAL -DSE 1 & DSE 2 LAB 60 Lectures

Marks : Pr (ESE: 3Hrs) =50	Pass Marks: Pr (ESE) = 20

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Mediasterilization, 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.

Group-B

1. Preparation of complex nutrient medium (Murashige & Skoog's medium)
2. To selection, Prune, sterilize and prepare an explant for culture.
3. Significance of growth hormones in culture medium.
4. To demonstrate various steps of Micropropagation.

III. CORE COURSE -C 11: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

BIOANALYTICAL TOOLS AND TECHNIQUES Theory: 60 Lectures

UNIT: I **(10 Periods)**

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

UNIT: II **(15 Periods)**

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

UNIT: III **(15 Periods)**

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 **(20 Periods)**

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.

Suggested Readings

- Karp, G. 2015. Cell and Molecular Biology: Concepts and Experiments. John Wieley & Sons.Inc
- De Robertis, E.D.P. and De Roberties, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: Molecular Approach. 5th edition. ASM Press & Sounderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J, and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

IV. CORE COURSE -C 12: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

RECOMBINANT DNA TECHNOLOGY Theory: 60 Lectures

UNIT: I (10 Periods)

Molecular tools and applications -restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors: pBR322, pUC 18. Bacteriophage-derived vectors/ lambda phage vectors. Artificial chromosomes, Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT: II (20 Periods)

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 (10 Periods)

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 (15 Periods)

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and Arhizogenes, 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.

Suggested Readings:

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

BIOTECHNOLOGY PRACTICAL -C 11 & C12 LAB — 60 Lectures

Marks : Pr (ESE: 3Hrs) =50	Pass Marks: Pr (ESE) = 20

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. SDS-polyacrylamide slab gel electrophoresis of proteins.
2. Preparation of protoplasts from leaves.
3. Separation of amino acids by paper chromatography.
4. To identify lipids in a given sample by TLC.

Group-B

1. Isolation of chromosomal DNA from plant cells
2. Qualitative and quantitative analysis of DNA using spectrophotometer
3. Plasmid DNA isolation
4. Making competent cells
5. Demonstration of PCR

SEMESTER VI — 4 Papers

Total 100 x 4 = 400 Marks

I. BIOTECHNOLOGY SPECIFIC (DSE 3): (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

BIOINFORMATICS AND BIOSTATISTICS — Theory: 60 Lectures

BIOINFORMATICS

UNIT: I **(10 Periods)**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, UniProt, Understanding the structure of each source and using it on the web.

UNIT: II **(20 Periods)**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction to BLAST, using it on the web. Multiple Sequence Alignment, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.

BIOSTATISTICS

UNIT: III **(12 Periods)**

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Mean, Median, Mode, Standard deviation and Dispersion.

Probability classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT: IV **(10 Periods)**

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

Suggested Readings for Bioinformatics:

- Abraham, C.M. 1999. *Environmental Jurisprudence in India*. Kluwer Law International.
- Agarwal, V.K. 2005. Environmental Laws in India: Challenges for Enforcement. *Bulletin of the National Institute of Ecology* **15**: 227-238.
- Divan, S. & Rosencranz, A. 2001. *Environmental Law and Policy in India*. Oxford University Press.
- Divan, S. & Rosencranz, A. 2002. *Environmental Law and Policy in India: Cases, Materials and Statues* (2nd edition). Oxford University Press.
- Gupta, K.R. 2006. *Environmental Legislation in India*. Atlantic Publishers and Distributors.
- Leelakrishnan, P. 2008. *Environmental Law in India* (3rd edition). LexisNexis India.
- Naseem, M. 2011. *Environmental Law in India Mohammad*. Kluwer Law International.
- Venkat, A. 2011. *Environmental Law and Policy*. PHI Learning Private Ltd.

Suggested Readings for Biostatistics:

- Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
- Glaser AN (2001) High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA
- Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
- Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley andSons Inc.

II. BIOTECHNOLOGY SPECIFIC (DSE 4):

(Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

ENVIRONMENTAL BIOTECHNOLOGY

Theory: 60 Lectures

UNIT: I **(18 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT: II **(20 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT: III **(12 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT: IV **(10 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

Suggested Readings:

- Environmental Science, S.C. Santra
- Environmental Biotechnology, Pradipta Kumar Mohapatra
- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
- Introduction to Environmental Biotechnology, Milton Wainwright
- Principles of Environmental Engineering, Gilbert Masters
- Wastewater Engineering – Metcalf & Eddys

BIOTECHNOLOGY PRACTICAL -DSE 3 & DSE 4 LAB 60 Lectures

Marks : Pr (ESE: 3Hrs) =50	Pass Marks: Pr (ESE) = 20

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, UniProt, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Sequence alignment using BLAST.

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

Group-B

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. 4. Bacterial Examination of Water by MPN Method.

III. CORE COURSE -C 13: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):

*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):

*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

BIOPROCESS TECHNOLOGY Theory: 60 Lectures

UNIT: I (10 Periods)

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 (20 Periods)

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, Inoculum development and sterilization.

UNIT: III (15 Periods)

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system.

UNIT: IV (15 Periods)

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

Suggested Readings:

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

IV. CORE COURSE -C 14: (Credits: Theory-04, Practicals-02)

Marks : 15 (MSE: 1Hr) + 60 (ESE: 3Hrs) =75	Pass Marks: Th (MSE +ESE) = 30

Instruction to Question Setter for

Mid Semester Examination (MSE):
*There will be **two** group of questions. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type** three questions of five marks each, out of which any two are to answer.*

End Semester Examination (ESE):
*There will be **two** group of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

GENOMICS AND PROTEOMICS **Theory: 60 Lectures**

UNIT: I **(15 Periods)**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT: II **(10 Periods)**

Managing and Distributing Genome Data: Web based servers and softwares for genomeanalysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT: III **(20 Periods)**

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT: IV **(20 Periods)**

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *Denovo* sequencing using mass spectrometric data.

Suggested Readings

- Genes IX by Benjamin Lewin, Johns and Bartlett Publisher.2006
- Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing,1987.
- Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
- Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
- Principles of Gene Manipulation 6th Edition, S.B. Primrose, R.M. Twyman and R.W. Old. Blackwell Science, 2001.
- Snustad, D.P., Simmons, M.J.(2009). Principles of Genetics. V Edition. John wiley and sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009) Concept of Genetics. IX Edition. Benjamin Cummings.
- Russell, P.J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASMPress, Washington.
- Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John wiley and Sons.

BIOTECHNOLOGY PRACTICAL -C 13 & C14 LAB 60 Lectures

Marks : Pr (ESE: 3Hrs) =50	Pass Marks: Pr (ESE) = 20

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. The questions in practical examination will be so framed that the students are able to answer them within the stipulated time.

Evaluation of Practical Examination may be as per the following guidelines:

Experiment	*= 30 marks*
Practical record notebook	*= 10 marks*
Viva-voce	*= 10 marks*

Group-A

1. Bacterial growth curve.
2. Production and analysis of ethanol.
3. Production and analysis of lactic acid.
4. Isolation of industrially important microorganism from natural resource.

Group-B

1. Use of SNP databases at NCBI and other sites
2. Detection of Open Reading Frames using ORF Finder
3. Proteomics 2D PAGE database
4. Softwares for Protein localization.
5. Native PAGE
6. SDS-PAGE

St. Xavier's College, Ranchi
Department of Biotechnology

LIST OF EXAMINERS, BIOTECHNOLOGY

Academic Year 2025-2026

S.No.	Name of College/Univ./Institute	Name of Examiner
1	PG Dept of Biotechnology, RU, Ranchi.	Dr. Ladly Rani, Assistant professor Director-PG Dept of Biotechnology, RU, Ranchi. 9470347346
2		Dr.Vinay Oraon Assistant professor PG Dept of Biotechnology, RU, Ranchi. 9955049070
3		Dr. Rupa Verma Assistant professor PG Dept of Biotechnology, RU, Ranchi. 7479736099
4		Dr. Anita Sinha Assistant professor PG Dept of Biotechnology, RU, Ranchi. 8789022705
5	Dept of Biotechnology,Marwari College, Ranchi.	Shristi Kumari Assistant Professor, Dept of Biotechnology,Marwari College, Ranchi. 8877428570
6		Mrs. Pinki Sahu Assistant Professor Dept of Biotechnology,Marwari College, Ranchi. 8987457340
7	Dept of Biotechnology Ranchi Women's College, Ranchi	Dr. Supriya Shrivastava Assistant Professor Dept of Biotechnology Ranchi Women's College, Ranchi 7209667352
8		Dr. Soma Roy Assistant Professor Dept of Biotechnology Ranchi Women's College, Ranchi 9006001969
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14		Dr. Geetanjali Singh Asst. Professor, Department of Botany, DSPMU, Ranchi 9934158035
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17		Dr. Raju Poddar Professor, Dept of Biotechnology, BIT Mesra 9934447663
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19	Centre for life Sciences, School of Natural Sciences,	Dr. Manoj Kumar, Associate Professor,

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06/11/24

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23	Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi.	Dr.Biplab Sarkar, Principal Scientist, Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi. 9730661230
24		Dr. Ramya N. Scientist, Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi. 7701980974
25		Dr. K K Krishnani Joint Director (Academic) Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi. 8097667980
26		Dr. Soumajit Sarkar Scientist, Virology Indian Institute of Agricultural Biotechnology, Garhkhatanga, Ranchi. 9007597865