CRITERIA 1.1.2

The Programmes offered by the institution focus on employability/entrepreneurship/ skill development and their course syllabi are QM adequately revised to incorporate contemporary requirements.

Programme – B.Sc. Biotechnology

Color Coding: -

1) **EMPLOYABILITY**

2) **ENTREPRENEURSHIP**

3) **SKILL DEVELOPMENT**

Program outcomes, Program specific outcomes and Course outcomes

For

B.Sc. Biotechnology Syllabus

(2022 onwards)

NSU
JAMSHEDPUR
ESTD 2018

NETAJI SUBHAS UNIVERSITY Jamshedpur

Head
Department of Bio-Technology
Netaji Subhas University

School of Biotechnology

Netaji Subhas University

Dean Academics
Netaji Subhas University
Jamshedpur, Jharkhand

NETAJI SUBHAS UNIVERSITY

JAMSHEDPUR

B.SC BIOTECHNOLOGY

SYLLABUS

2022 ONWARDS

Department of Biotechnology

Mapping of B.sc Biotechnology Syllabus that focus on Employability, Entrepreneurship, and Skill Development:

Paper Code	Paper Name	(EM)	(EN)	(SD)
	Semester-I			
BSC 101	Cell structure &Biology	✓	✓	✓
BSC 102	IT/Pharma	✓		✓
BSC 103	Animal Physiology	✓		✓
BSC 104	Communication English	✓	✓	✓
	Semester II	✓		✓
BSC 201	Microbiology	✓	✓	✓
BSC 202	IT/ Pharma	✓		✓
BSC 203	Plant Physiology	✓		✓
BSC 204	English Language	✓	✓	✓
	Semester-III			
BSC 301	Biophysics and Biochemistry	✓		✓
BSC 302	IT/PharmaChemistry	✓		✓
BSC 303	EVS 1	✓	✓	✓
BSC 304	Entrepreneurship Development I	✓	✓	✓
	Semester-V			
BSC 401	Bioinstrumentation Biostatistics	✓	✓	✓
BSC 402	IT/Pharma chemistry	✓		✓
BSC 403	EVS II	✓	✓	✓
BSC 404	Entrepreneurship development II	✓	✓	✓

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Paper Code	Paper Name	(EM)	(EN)	(SD)
	Semester-V			
BSC 501	**Molecular Biology and Genetics Engineering**	✓	✓	✓
BSC 502	**IT/Pharma**	✓		✓
BSC 503	**Biotechnology Forensics Science**	✓		✓
BSC 504	**Intellectual property rights (IPR)**	✓	✓	✓
	Semester VI	✓		✓
BSC 601	**Applied biotechnology**	✓	✓	✓
BSC 602	**IT/Pharma**	✓		✓
BSC 603	**Project(Biotechnology)**	✓		✓
BSC 604	**Project(Pharma Chemistry) OR Project(Computer Science)**	✓	✓	✓

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Jamshedpur, Jharkhand

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Netaji Subhas University

NETAJISUBHASUNIVERSITY

DEPARTMENT OF BIOTECHNOLOGY

Vision: Provide in graduates equipped with excellent the critical knowledge and practical skills and promoting scientific research and community service.

Mission

To provide students a unique and multidisciplinary learning experience that will foster the young minds to develop as a researcher, entrepreneur etc. •

To enhance academic and industrial collaborative research initiatives for the development of biotechnological, food and therapeutic products.

• To emphasize an equip the students towards innovative industrial and research updates.

• To serve the society with out most commitment, integrity, enthusiasm, and dedication.

Programme Outcome:POs

PO-1	Understand and inculcate the ability to apply, update, extend and to develop deep knowledge through flexible, research intensive programed signed to meet the current demand of academia and industry.
PO-2:	Demonstrate professional integrity and ethical attitude with awareness of global and national competencies and think about the social entailment of their work, especially its impact on safety, health and environment for sustainable development.
PO-3	Apply the acquired practical skills and broad biotechnological training in product, process and inculcate leadership qualities for innovative entrepreneurship to meet the societal demands.
PO-4	Ability to design and conduct experiments, as well as to analyze and interpret scientific data.
PO-5	Awareness of contemporary issues that can be mitigated or supported through life science knowhow and biotechnology skills.
PO-6	Equipped with laboratory skills in biotechnology.
PO-7	Ability to integrate technologies through an inter-disciplinary learning habit.
PO-8	Demonstrate an independent thinking ability. Ability to communicate effectively.

ProgrammeSpeceficOutcome-PSOs

PSO-1 Toteachtheapplicationofbiotechnologyskillsincoreandrelatedfields, such as molecular and microbiology, immunology and genetic engineering, fermentation and bioprocess, enzyme and food technology, and bioinformatics.
PSO-2: Tofosterstudents'scientificcuriosityandgivethemtheideasandresearch methodologies they need for a future in biotechnology.
PSO-3:To meet industry and academic demands by providing students with comprehensive, practical oriented knowledge in a variety of biotechnology thrust areas.
PSO4: To demonstrate proficiency in applying technical concepts to biological systemsbydemonstratingaworkingknowledgeofadvancedbiologicalsciences.
PSO5:In order to solve biotechnological challenges,one must be a deptatusing sophisticated biological concepts and methods.
PSO6: Researching complicated issues in biotechnology an related fields by designing, executing, analyzing, and interpreting data.

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Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

SEMESTERI

S.No.	Code	Subject	Credit	ExaminationMarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC101	Biotechnology-I	4	40	10	-	50
2	BSC102	PharmaChemistry-I OR ComputerScience-I	4	40	10	-	50
3	BSC103	AnimalPhysiology	4	40	10	-	50
4	BSC101P	Biotechnology-I Practical	2	-	-	50	50
5	BSC102P	Pharma chemistryI OR Computerscience–I Practical	2	-	-	50	50
6	BSC103P	AnimalPhysiology Practical	2	-	-	50	50
7	BSC104	EnglishLanguage-I	4	40	10	-	50
		Total	**22**				**350**

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Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

Semester-II

S.No.	Code	Subject	Credit	ExaminationMarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC201	Biotechnology-II	4	40	10	-	50
2	BSC202	PharmaChemistry-II OR ComputerScience-II	4	40	10	-	50
3	BSC203	PlantPhysiology	4	40	10	-	50
4	BSC201P	BiotechnologyII Practical	2	-	-	50	50
5	BSC202P	PharmaChemistry-II OR ComputerScience-II Practical	2	-	-	50	50
6	BSC203P	PlantPhysiologyPractical	2	-	-	50	50
	BSC204	EnglishLanguage-II	4	40	10	-	50
		Total	**22**				**350**

NetajiSubhasUniversity

Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

SEMESTERIII

S.No.	Code	Subject	Credit	ExaminationMarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC301	Biotechnology-III	4	40	10		50
2	BSC302	PharmaChemistry-III OR ComputerScience-III	4	40	10		50
3	BSC303	EnvironmentalStudies-I	4	40	10	-	50
4	BSC304	Entrepreneurship Development-I	4	40	10	-	50
5	BSC301P	Biotechnology-III Practical	2	-	-	50	50
6	BSC302P	PharmaChemistry-III OR ComputerScience-III Practical	2	-	-	50	50
		Total	**20**				**300**

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Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

SEMESTERIV

S.No.	Code	Subject	Credit	ExaminationMarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC401	Biotechnology-IV	4	40	10		50
2	BSC402	PharmaChemistry-IV OR ComputerScience-IV	4	40	10		50
3	BSC403	EnvironmentalStudies-II	4	40	10	-	50
4	BSC404	Entrepreneurship Development-II	4	40	10	-	50
5	BSC401P	Biotechnology-IV Practical	2	-	-	50	50
6	BSC402P	PharmaChemistry-IV OR ComputerScience-IV Practical	2	-	-	50	50
		Total	**20**				**300**

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Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

SEMESTERV

S.No.	Code	Subject	Credit	ExaminationMarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC501	Biotechnology-V	4	40	10	-	50
2	BSC502	PharmaChemistry-V OR ComputerScience-V	4	40	10	-	50
3	BSC503	BiotechnologyForensics Science	4	40	10	-	50
4	BSC504	Intellectualproperty rights (IPR)	4	40	10	-	50
5	BSC501P	Biotechnology-V Practical	2			50	50
6	BSC502P	PharmaChemistry-V OR ComputerScienceV Practical	2			50	50
		Total	**20**				**300**

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Syllabusfor3-YearsB.Sc.(Honours)Biotechnology

Semester-VI

S.No.	Code	Subject	Credit	Examination MarksDetail			
				External Exam	Internal Exam	Practical	Total
1	BSC601	Biotechnology-VI	4	40	10	-	50
2	BSC602	PharmaChemistry-VI OR ComputerScience-VI	4	40	10	-	50
3	BSC603	Project(Biotechnology)	10	-	-	-	100
4	BSC604	Project(PharmaChemistry) OR Project(ComputerScience)	10	-	-	-	100
5	BSC601P	Biotechnology-VIPractical	2	-	-	50	50
6	BSC602P	PharmaChemistry-VI OR ComputerScience-VI Practical	2	-	-	50	50
		Total	**32**				**400**

B.SC BIOTECHNOLOGY

Course Outcomes Of
BSC 101Cell Biology

Upon successful completion of the **Cell Biology** course, students will be able to:

1. *Explain Cell Structure and Function*
    - Identify and describe the differences between prokaryotic and eukaryotic cells, their organelles, and their specific functions.
2. *Understand Molecular Composition of Cells*
    - Demonstrate knowledge of biomolecules (proteins, lipids, carbohydrates, and nucleic acids) and their roles in cellular activities.
3. *Analyze Cellular Processes and Metabolism*
    - Explain membrane transport mechanisms, enzyme functions, energy metabolism (cellular respiration, photosynthesis), and homeostasis.
4. *Comprehend Genetic and Molecular Basis of Life*
    - Describe DNA replication, gene expression, transcription, and translation, and understand their regulation.
5. *Understand Cell Cycle and Division*
    - Explain the stages of the cell cycle, mitosis, meiosis, and apoptosis, and their significance in growth and development.

Course Outcomes of

BSC103Animal Physiology

Upon successful completion of the **Animal Physiology** course, students will be able to:

1. *Explain the Principles of Animal Physiology*
   - Describe the fundamental physiological processes that regulate homeostasis and maintain life functions in animals.
2. *Understand Organ System Functions*
   - Identify and explain the structure and function of major organ systems, including circulatory, respiratory, digestive, excretory, nervous, endocrine, and reproductive systems.
3. *Analyze Neurophysiological and Endocrine Mechanisms*
   - Explain how the nervous and endocrine systems coordinate body functions through neural signaling and hormonal regulation.
   -
4. *Describe Energy Metabolism and Nutrient Utilization*
   - Understand metabolic pathways, thermoregulation, and the physiological mechanisms of digestion and absorption.
5. *Explain Circulatory and Respiratory Processes*
   - Analyze the transport of gases, blood circulation, and adaptations of the cardiovascular and respiratory systems to different environments.
6. *Understand Muscle Physiology and Movement*
   - Describe the mechanisms of muscle contraction, biomechanics, and the role of the skeletal and muscular systems in locomotion.

Course Outcomes of

Microbiology

Upon successful completion of the **Microbiology** course, students will be able to:

1. *Explain the Fundamentals of Microbiology*
   - Describe the history, scope, and significance of microbiology in various fields, including medicine, industry, and environmental sciences.
2. *Classify and Characterize Microorganisms*
   - Identify and differentiate between major microbial groups such as bacteria, viruses, fungi, protozoa, and algae based on their structure, function, and classification.
3. *Understand Microbial Structure and Physiology*
   - Explain the cellular organization, morphology, growth requirements, and metabolic pathways of different microorganisms.
4. *Demonstrate Knowledge of Microbial Growth and Control*
   - Apply knowledge of microbial growth kinetics, culture methods, sterilization, and disinfection techniques in laboratory and industrial settings.

5. *Analyze Microbial Metabolism and Genetics*
    - Understand microbial enzymatic processes, metabolic pathways, gene expression, mutations, and genetic engineering applications.

Course Outcomes of **Biostatistics and Bioinformatics**

Upon successful completion of the **Biostatistics and Bioinformatics** course, students will be able to:

Biostatistics Outcomes:

1. *Understand and Apply Basic Statistical Concepts*
    - Explain key statistical principles and their relevance in biological and medical research.
2. *Perform Data Collection and Experimental Design*
    - Design experiments, collect biological data, and apply appropriate statistical methods for analysis.
3. *Apply Descriptive and Inferential Statistical Methods*
    - Use measures of central tendency, variability, probability distributions, hypothesis testing, and confidence intervals in biological studies.
    - Conduct correlation and regression analysis to study relationships in biological datasets.

Bioinformatics Outcomes:

1. *Understand the Fundamentals of Bioinformatics*
    - Explain the importance of computational tools in genomics, proteomics, and systems biology.
2. *Use Biological Databases for Sequence Analysis*
    - Retrieve and analyze genetic and protein sequences using databases such as GenBank, UniProt, and EMBL.
3. *Perform Sequence Alignment and Phylogenetic Analysis*
    - Apply bioinformatics tools like BLAST, ClustalW, and MEGA for molecular sequence comparisons.
4. *Analyze Genomic and Proteomic Data Using Computational Tools*
    - Use software for gene prediction, protein structure modeling, and

functional annotation.

Course Outcomes of

Environmental Science (EVS)

Upon successful completion of the **Environmental Science** course, students will be able to:

1. *Understand the Fundamentals of Environmental Science*
    - Explain key environmental concepts, ecosystems, and the importance of biodiversity conservation.
2. *Analyze Natural Resources and Their Sustainable Use*
    - Assess the utilization and conservation of resources like air, water, soil, forests, and minerals.
3. *Identify and Evaluate Environmental Pollution*
    - Recognize sources, impacts, and control measures for air, water, soil, and noise pollution.
4. *Assess Climate Change and Global Environmental Issues*
    - Understand the causes and consequences of global warming, ozone depletion, and deforestation.
5. *Apply Waste Management and Sustainable Practices*
    Implement techniques such as recycling, composting, and waste treatment for environmental sustainability

Course Outcomes of

Entrepreneurship

Upon successful completion of the **Entrepreneurship** course, students will be able to:

1. *Demonstrate an Understanding of Entrepreneurship Concepts*
    - Explain the role of entrepreneurship in economic growth and business development.
2. *Develop an Entrepreneurial Mindset*
    - Apply creativity, innovation, risk-taking, and problem-solving skills in business decision-making.
3. *Identify and Evaluate Business Opportunities*
    - Conduct market research and feasibility analysis to identify potential business ventures.
4. *Create a Business Plan and Strategy*
    - Develop a structured business plan, including financial projections, marketing strategies, and operational plans.

5. *Understand Financial and Funding Aspects*
    - Identify sources of funding, manage financial resources, and create effective financial strategies for startups.

Course Outcomes of

Molecular Biology

Upon successful completion of the **Molecular Biology** course, students will be able to:

1. *Understand the Structure and Function of Biomolecules*
    - Explain the roles of DNA, RNA, and proteins in cellular and molecular processes.
2. *Analyze DNA Replication, Repair, and Recombination Mechanisms*
    - Describe the molecular mechanisms of DNA synthesis, mutation repair, and genetic recombination.
3. *Explain Gene Expression and Regulation*
    - Understand transcription, translation, and regulatory pathways controlling gene expression in prokaryotic and eukaryotic cells.
4. *Explore Molecular Mechanisms of Genetic Control*
    - Analyze epigenetic modifications, operon systems, and gene silencing mechanisms.
5. *Understand Protein Synthesis and Post-Translational Modifications*
    - Describe the function of ribosomes, tRNA, chaperones, and protein-folding pathways.

Course Outcomes of

Forensic Science

Upon successful completion of the **Forensic Science** course, students will be able to:

1. *Demonstrate an Understanding of Forensic Science Principles*
    - Explain the role, history, and significance of forensic science in criminal investigations and the legal system.
2. *Apply Crime Scene Investigation Techniques*
    - Utilize proper methods for crime scene documentation, evidence collection, and preservation.

3. *Analyze Physical and Biological Evidence*
    - Identify and interpret fingerprints, bloodstains, DNA, hair, and fiber evidence using forensic techniques.
4. *Examine Forensic Toxicology and Drug Analysis*
    - Detect and analyze drugs, poisons, and toxins in biological samples.
5. *Utilize DNA Profiling for Identification*
    - Apply molecular biology techniques such as PCR and STR analysis for forensic identification.

Course Outcomes of

Intellectual Property Rights (IPR)

Upon successful completion of the **Intellectual Property Rights (IPR)** course, students will be able to:

1. *Demonstrate an Understanding of Intellectual Property (IP) Concepts*
    - Explain the significance of IPR in protecting innovations, creativity, and business assets.
2. *Differentiate Various Types of Intellectual Property*
    - Identify and describe patents, copyrights, trademarks, trade secrets, geographical indications, and industrial designs.
3. *Apply Patent Laws and Filing Procedures*
    - Understand the process of patent filing, examination, grant, and maintenance at national and international levels.
4. *Analyze Copyright Protection and Fair Use Policies*
    - Explain the legal aspects of copyright protection in literary, artistic, and digital works.
5. *Understand Trademark Laws and Brand Protection Strategies*
    - Evaluate the importance of trademarks and their role in brand identity and business growth.

Course Outcomes of

Applied Biotechnology

Upon successful completion of the **Applied Biotechnology** course, students will be able to:

1. *Demonstrate an Understanding of Biotechnology Principles*
    - Explain the fundamental concepts and applications of biotechnology in various fields.
2. *Apply Genetic Engineering and Recombinant DNA Technology*
    - Utilize gene cloning, vector systems, and genome editing techniques like CRISPR for biotechnological advancements.
3. *Analyze the Role of Biotechnology in Healthcare*
    - Evaluate the development and application of biopharmaceuticals, vaccines, gene therapy, and molecular diagnostics.
4. *Utilize Biotechnology for Agricultural Improvement*
    - Explain the benefits of genetically modified organisms (GMOs), biofertilizers, and pest-resistant crops.
5. *Implement Industrial Biotechnology and Bioprocessing Techniques*
    - Apply fermentation, enzyme engineering, and biomanufacturing techniques for industrial applications.

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BSC-101–BIOTECHNOLOGY-I

CELLSTRUCTURE&BIOLOGY

MAX.MARKS:40+10

No.ofLecturesperWeek:02Hours **TOTALLECTURES:32**

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

ThecourseobjectivesofCellBiology

1. Understanding CellStructure&Function
   - Learnabout prokaryoticandeukaryoticcells,theirorganelles, andtheirspecificfunctions.
2. MolecularCompositionofCells
   - Studythebiomolecules(proteins,lipids,carbohydrates,andnucleicacids)that makeupthecell and their roles.
3. CellularProcesses&Metabolism
   - Explorecellsignaling,membranetransport,energyproduction(cellularrespiration, photosynthesis), and enzyme functions.
4. GeneticandMolecular BasisofLife
   - UnderstandDNAreplication,transcription,translation,andgeneexpressionregulation.
5. CellCycle&Division
   - Learnaboutmitosis,meiosis,andthe mechanismsthatregulatecellproliferationandapoptosis.

Unit-I
CellStructure&Theory,Structureofprokaryoticcell,EubacteriaandArchaebacteria. Size,shapeandarrangementofbacterialcells.Gram'spositiveandGram'snegativecells. StructureofEukaryoticcell,plantcells,animalcells.Differencebetweenprokaryoticand eukaryoticcells.
Unit-II
Structureand function of bacterial cell — flagella, pill, Cell wall, cytoplasmic membrane, nuclearregion,mesosomes, ribosomes,vacuoles. Structure and function of eukaryotic cell — Cell wall, cell membrane, mitochondria, chloroplast, endoplasmic reticulum, Golgi bodies, nucleus, cytoskeleton, microbodies, Centriole,Lysosome.
Unit-III
Cellcycleandcelldivision-mitosis,meiosis.Anomaliesincelldivisionandassociateddiseases. Cell synchrony, Cell-cell interactions.
Unit-IV
Transport Process: CellMembrane: Modelsofmembranestructure,Membraneproteinsand theirproperties,Membranecarbohydratesandtheirroles.Transportacrossmembranes—active andpassivediffusion,mechanisms.
Unit-V
IntroductiontoNecrosis,Senescence,Apoptosis—Programmedcelldeath.Mechanismof Apoptosis,Intrinsic&Extrinsicpathwaysof celldeath,ApoptosisinrelationtoCancer, Oncogenes — Types of cancer.

BOOKS:

1. MolecularBiologyofthecell,2002:Albert'setal
2. Thecell:Amolecularapproach:J.M.Cooper
3. Cellbiology:P.S.VermaandV.K.Agarval
4. CellandMolecularBiology:P.K.Gupta
5. ExperimentsinBiotechnology:NighojkarandNighojkar
6. ApracticalbookofMolecularBiologyandImmunology;2017:P.K.Singh*etal*

BIOTECHNOLOGY-IPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. Tostudytheplantcellstructureusingvariousplantmaterials.
2. TostudymicrobialcellbyMonochromestainsandGramstaining.
3. Topreparеandstudythedifferentstagesofmitosisandmeiosis.
4. Prepareslideforstudyofstomata.
5. Studyofpermanentslideslikecelldivision,prokaryoticandeukaryoticcells,Musclesand Nerve cells, T.S. ofstomata.
6. Tostudytheanimalcellstructureusingcheekcells.
7. Histochemicallocalizationofflagellin.
8. Viablecellcountingusinghaematocytometer.
9. Measurementofcellbylightmicroscope:-Calibrationofocularmicrometer,findingout average cellsize
10. SeparationofcelltypesfrombloodbyTLC/differentialcounting.
11. Methodsofcelllysis:ruptureosmotic/chemical/enzymatic.

CourseOutcomesofCellBiology

Uponsuccessfulcompletionofthe**CellBiology**course,studentswill beableto:

1. **ExplainCellStructureand Function**
   - Identifyanddescribethedifferencesbetweenprokaryoticandeukaryoticcells,theirorganelles,andtheir specific functions.
2. **UnderstandMolecularComposition ofCells**
   - Demonstrateknowledgeofbiomolecules(proteins,lipids,carbohydrates,andnucleicacids)andtheirroles in cellular activities.
3. **AnalyzeCellularProcessesandMetabolism**
   - Explainmembranetransportmechanisms,enzymefunctions,energymetabolism(cellularrespiration, photosynthesis), and homeostasis.
4. **Comprehend GeneticandMolecularBasisofLife**
   - DescribeDNAreplication,geneexpression,transcription,andtranslation,andunderstandtheirregulation.
5. **UnderstandCellCycle andDivision**
   - Explainthestagesofthecellcycle, mitosis, meiosis, andapoptosis, andtheir significanceingrowthand development.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	3	3	3
CO3	2	0	1	1	3	0	2	1	0	2
CO4	0	1	2	1	1	1	1	0	2	0
CO5	1	0	1	1	3	2	1	0	1	1

BSC-102–ANIMALPHYSIOLOGY

MAX.MARKS:40+10

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofAnimalPhysiology

The**AnimalPhysiology**courseaimstoprovidestudentswithafundamentalunderstandingofthephysiological processes that regulate and maintain life in animals. The key objectives include:

1. **UnderstandtheFundamentalPrinciplesofAnimalPhysiology**
   - Learnthebasicconceptsofhomeostasis,biologicalregulation, andphysiologicaladaptationsindifferent animal species.
2. **ExploretheStructureandFunctionofOrganSystems**
   - Studytheanatomyandphysiologyofmajor organsystems,includingcirculatory,respiratory, digestive, excretory, nervous, endocrine, and reproductive systems.
3. **AnalyzeNeurophysiologyandEndocrineRegulation**
   - Understandthefunctionsofthenervoussystem,signaltransmission, andhormonalcontrolmechanismsin animals.
4. **ComprehendEnergyMetabolismandNutrientUtilization**
   - Learnhowanimalsgenerateandutilizeenergy,includingmetabolicpathways, thermoregulation, and nutrient absorption.
5. **ExamineCirculatoryandRespiratorySystems**
   - Studythemechanismsofoxygentransport,bloodcirculation, gasexchange, andadaptationstodifferent environmental conditions.

Unit-I	**12Lectures**
Digestion Digestion: Definitionandtypes(extraandintracellulardigestion);Digestion,absorptionand assimilationof Carbohydrates.	
Unit-II	12Lectures
Respiration DefinitionofRespirationandRespiratorymechanisms–External,Internalandcellular. RespiratoryPigments;Transportofoxygen,Oxygendissociationcurves.Bohr'seffect	
Unit-III	**14Lectures**
Circulation: Typesofcirculation-OpenandClosedcirculation;Bloodanditstypesandfunction	
Unit-IV	**12Lectures**
Excretion Defination;Classification(Ammonotelic,Uricotelic,Ureotelic),StructureandfunctionofNephron	
Unit-V	**14Lectures**
EndocrineSystem Endocrineglands-Structure,secretionsandfunctionsofPituitary,Thyroid,Parathyroid,Adrenalglandsand Pancreas	

BOOKS:

1. Hughes,G.M.ComparativePhysiologyofvertebraterespiration(1963)Cambridge.
2. GuytonandHall(2001)textbookofmedicalphysiology.
3. Schmidt–Neilson,K(2002)Animalphysiology,Adaptationandenvironment
4. CellandMolecularBiology:P.K.Gupta
5. Websteir,R.Neurotransmitters,drugsandbrainfunction.
6. ApracticalbookofMolecularBiologyandImmunology;2017:P.K.Singh*et*al

BIOTECHNOLOGY-IPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. Qualitativetestsforidentificationofcarbohydrates.
2. Qualitativetestsforidentificationofproteins
3. Qualitativetestsforidentificationoflipids
4. Qualitativetestsforidentificationofammonia.
5. Qualitativetestsforidentificationofurea
6. EstimationofHaemoglobinbySahlismethod.
7. EstimationoftotalproteinbyLowry'smethod
8. BloodTest

CourseOutcomesofAnimalPhysiology

Uponsuccessfulcompletionofthe**AnimalPhysiology**course,studentswillbeable to:

1. **Explain thePrinciplesofAnimalPhysiology**
   - Describethefundamentalphysiologicalprocesses thatregulatehomeostasis andmaintainlifefunctions in animals.
2. **UnderstandOrganSystemFunctions**
   - Identifyandexplainthestructureandfunctionof major organsystems, includingcirculatory, respiratory, digestive, excretory, nervous, endocrine, and reproductive systems.
3. **AnalyzeNeurophysiologicalandEndocrineMechanisms**
   - Explainhowthenervousandendocrinesystemscoordinatebodyfunctionsthroughneuralsignalingand hormonal regulation.
   -
4. **DescribeEnergyMetabolismand Nutrient Utilization**
   - Understandmetabolicpathways,thermoregulation, andthephysiologicalmechanismsofdigestionand absorption.
5. **ExplainCirculatoryandRespiratoryProcesses**
   - Analyzethetransportofgases, bloodcirculation, andadaptations ofthecardiovascular andrespiratory systems to different environments.
6. **UnderstandMusclePhysiologyandMovement**
   - Describethemechanismsof musclecontraction, biomechanics, andtheroleoftheskeletalandmuscular systems in locomotion.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	3	1	0	2	0	3	0	3	3	3
CO3	2	1	1	1	3	0	2	1	0	2
CO4	0	1	2	1	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	0	1	1

BSC-201–BIOTECHNOLOGY-II MICROBIOLOGY

MAX.MARKS:40+10 **TOTALLECTURES:32**

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

CourseObjectivesofMicrobiology

The**Microbiology**courseaimstoprovidestudentswithafundamentalunderstandingofmicroorganisms, their structure, function, and roles in health, industry, and the environment. The key objectives include:

1. **UnderstandtheFundamentalsofMicrobiology**
   - Learnthehistory,scope,andimportanceofmicrobiologyinvariousfields.
2. **ClassifyandDescribeMicroorganisms**
   - Studythecharacteristics,classification,anddiversityofbacteria,viruses,fungi,protozoa,andalgae.
3. **ExplainMicrobialStructureand Function**
   - Understandthecellularorganization,physiology,andreproductionof microorganisms.
4. **UnderstandMicrobialGrowthandControl**
   - Learnaboutmicrobialgrowthconditions,culturetechniques,andmethodsforcontrollingmicrobial populations.
5. **ExploreMicrobialMetabolismand Genetics**
   - Studymetabolicpathways,enzymefunctions, microbialgenetics,andgeneexpressionregulation.

Unit-I
IntroductionofMicrobiologyHistory,Applications&StatusofMicrobiologyinIndia.Classificationof Microorganisms-GeneralFeatures,systemsofClassification.
Unit-II
StructureandDiversityofBacteria&Virus,Microbesinextremeenvironment.Nutritionalrequirement of microbes. Bacteriology:Morphologyandultra-structureofbacteriaanditsmorphologicaltypes, Archaebacteria.
Unit-III
Variousmethodsofstaining:Simple,Gramstaining,Endosporestainingandcapsulestaining.
Unit-IV
Microbialgrowth—mathematicalexpressionofgrowth,growthcurve,factorsaffectinggrowth. Quantification of microbial growth. Controlofmicroorganisms-physical&chemical,Evaluationofchemicaldisinfectants-tubedilution test, agar diffusion test and phenol- coefficient.
Unit-V
Microbial Nutrition and metabolism- Microbial Metabolism- Concept of Anabolism& catabolismprocesses.NitrogenFixation-Typesandmechanisms,Microbial diseaseinplants&Animals (Only General concept). FermentationProcess—Fermenter&itsmicrobesofindustrialimportance.

BOOKS:

1. TextbookofMicrobiology:Prescott
2. TextbookofMicrobiology:Pelczar,PelczarandChan
3. TextbookofMicrobiology:RCDubeyandDKMaheshwari
4. GeneralMicrobiologyVol.IandII:PowarandDhagniwala
5. ExperimentsinBiotechnology:NighojkarandNighojkar
6. Experimentsinmicrobiology,plantpathologyandBiotechnology:KRAneja
7. Microbiology;Apracticalapproach:BhaveshPatel

BIOTECHNOLOGY-IIPRACTICALS

BIOTECHNOLOGY-IPRACTICALS **MAX.MARKS:50**

No.ofLaboratoryperWeek:06Hours

1. Asepticteчniques,Cleaningofglassware,Preparationofcottonpluggingand sterilization.
2. IsolationofMicrobesfromAir,WaterandSoil.
3. Dilutionandplatingbypourplate,SpreadPlateMethods.
4. StainingMethod—GramStaining,EndosporeStaining,FungalStaining.Algal staining.
5. IdentificationofBacteriabasedonstaining,shapeandsize.
6. AntibioticSensitivityofMicrobesbytheUseofAntibioticDiscs.
7. IsolationandIdentificationofaquaticFungifromLocalwaterbody.
8. IsolationandCharacterisationofgreenalgaefromNaturalhabitats.
9. Measurementofwaterandsoil,pH.

CourseOutcomesofMicrobiology

Uponsuccessfulcompletionofthe**Microbiology**course,studentswillbe able to:

1. **ExplaintheFundamentalsofMicrobiology**
   - Describethehistory,scope,andsignificanceofmicrobiologyinvariousfields,includingmedicine, industry, and environmental sciences.
2. **ClassifyandCharacterize Microorganisms**
   - Identifyanddifferentiatebetweenmajormicrobialgroupssuchasbacteria,viruses,fungi,protozoa,and algae based on their structure, function, and classification.
3. **UnderstandMicrobialStructureand Physiology**
   - Explainthecellularorganization, morphology,growthrequirements,andmetabolicpathwaysofdifferent microorganisms.
4. **DemonstrateKnowledgeofMicrobialGrowthand Control**
   - Applyknowledgeofmicrobialgrowthkinetics,culturemethods,sterilization,anddisinfectiontechniques in laboratory and industrial settings.
5. **AnalyzeMicrobialMetabolismand Genetics**
   - Understandmicrobial enzymaticprocesses,metabolicpathways,geneexpression,mutations,andgenetic engineering applications.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	0	1	0	2	0	3	0	3	3	2
CO3	2	1	1	1	3	0	2	1	0	2
CO4	0	2	2	1	1	1	1	0	0	0
CO5	1	0	1	1	0	0	1	0	1	1

BSC-202–PLANTPHYSIOLOGY

MAX.MARKS:40+10
No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofPlantPhysiology

The**Plant Physiology**courseaimstoprovidestudentswithacomprehensiveunderstandingofthefunctionaland physiological processes in plants. The key objectives include:

1. **UnderstandtheFundamentalConceptsofPlantPhysiology**
   - Learnthebasicprinciplesofplantstructure,function,andgrowthprocesses.
2. **ExplorePlantWaterRelationsandMineralNutrition**
   - Studythemechanismsof water uptake, transport,transpiration, andtheroleofessentialnutrientsinplant growth and metabolism.
3. **AnalyzePhotosynthesisandRespiration**
   - Understandthebiochemicalpathwaysofphotosynthesis,respiration,andtheirsignificanceinenergy production and plant metabolism.
4. **ExaminePlant GrowthandDevelopment**
   - Studyplanthormones,growthregulators,photoperiodism,seedgermination,andfloweringmechanisms.
5. **UnderstandTransportMechanismsin Plants**
   - Learnaboutphloemandxylemtransport,translocationof nutrients,andsource-sinkrelationships.
6. **StudyStressPhysiologyand Adaptations**
   - Analyzeplantresponsestoabiotic(drought, salinity,temperature)andbiotic(pathogens, herbivores) stresses.

Unit-I	**14Lectures**
Plant waterrelations,Diffusion,Osmosis,Watertransportmechanisms,TranspirationandStomatal physiology.	
Unit-II	**12Lectures**
MineralsNutritioninplants:typesandfunctionanddeficiencydisease.	
Unit-III	**14Lectures**
PhotosynthesisandGeneralconceptofphotosynthesis,photosynthesispigment,C2,Calvincycle, C4cycleandCAMpathway.	
Unit-IV	**12Lectures**
Respiration:Photooxidationofwater,glycolysis,TCAcycleandATPsynthesis.	
Unit-V	**12Lectures**
Plant growthregulators:Definition,Types(Auxins,Cytokinins,Gibberellin's,Ethylene& ABA)andApplication.	

BOOKS:

1. TextbookofplantpathologyAgrios,AcademicPressLondon.
2. Plantphysiology,Delvin,YanNostrandReinholdcomp.NewYork.
3. TextbookofvariousadaptationofplantsJonesA.DAndwillbins.
4. Lyndon,R.F1990Plantdevelopment,Thecellularbasis
5. TayalM.S1996Plantanatomy.Rastogipublication,Meerut.

BIOTECHNOLOGY-IIPRACTICALS

BIOTECHNOLOGY-I PRACTICALS MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. ToperformOsmosis,andDiffusion
2. TomeasureTranspirationrate
3. TomeasurechlorophyllcontentsofplantLeaves
4. Tostudiesvariousdiseaseinplants
5. Tostudiesdifferentplantgrowthrequlator

CourseOutcomesofPlantPhysiology

Uponsuccessfulcompletionofthe**Plant Physiology** course,studentswillbeableto:

1. **ExplaintheFundamentalPrinciplesofPlant Physiology**
   - Demonstrateanunderstandingofplantstructure, function,andphysiologicalprocesses.
2. **UnderstandPlant-WaterRelationsandMineralNutrition**
   - Describewaterabsorption,transpiration,nutrientuptake,andtheirrolesinplantgrowthandmetabolism.
3. **AnalyzePhotosynthesisandRespiration**
   - Explainthebiochemicalpathways ofphotosynthesis andrespirationandtheir significanceinenergy production.
4. **DescribePlantGrowthandDevelopmentMechanisms**
   - Understandtheroleofplanthormones,photoperiodism, andenvironmentalfactorsinregulatingplant growth.
5. **ExplainTransport Mechanismsin Plants**
   - Analyzehowwater,nutrients,andorganicsubstancesaretransportedthroughxylemandphloem.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	0	1	0	2	0	3	0	3	3	3
CO3	2	1	1	1	3	0	1	1	0	2
CO4	0	1	0	1	1	1	1	0	2	0
CO5	1	0	1	1	0	1	2	0	1	1

BSC-301–BIOTECHNOLOGY-III
BIOPHYSICSANDBIOCHEMISTRY

MAX.MARKS:40+10

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

CourseObjectivesofBiophysicsandBiochemistry

The**BiophysicsandBiochemistry** courseaimstoprovidestudentswithafundamentalunderstanding ofthe physical and chemical principles governing biological systems. The key objectives include:

BiophysicsObjectives:

1. **UnderstandthePhysicalBasisofBiologicalProcesses**
   - Learnhowprinciplesofphysics, suchasthermodynamics, fluidmechanics, andelectromagnetism, applyto biological systems.
2. **ExploreBiomolecularInteractions**
   - Studythephysicalforcesgoverningproteinfolding,enzymeactivity,andmolecularrecognition.
3. **AnalyzeBiomechanicsand Bioenergetics**
   - Understandthephysicalprinciplesbehindmusclecontraction,cellularmotility,andenergytransformations in biological systems..

BiochemistryObjectives:

6. **UnderstandtheStructureandFunction ofBiomolecules**
   - Learnaboutproteins,nucleicacids,carbohydrates,andlipidsandtheir roleincellularprocesses.
7. **ExploreEnzymeKineticsandMetabolism**
   - Studyenzymemechanisms,metabolicpathways,andenergyproductioninbiologicalsystems.

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Unit-I	**12Lectures**
Thermodynamics: ThermodynamicSystem,Equilibrium,Thermodynamiclawsandtheir applications.DifferenttypesofprocessesThermodynamicvariablesandEntropy.	
Unit-II	**12Lectures**
GeneralBiophysicalmethods: MeasurementofpH,Radioactivelabeling&counting, Autoradiography.Diffusion,Sedimentation,Osmosis.	
Unit-III	**14Lectures**
FundamentalsofBiochemistry:Biochemistryasmolecularlogicoflivingbeings..Chemical elements,structureofatoms,moleculesandchemicalbonds.Ionic,covalent,coordinateand hydrogenbonds.Structure,functionandpropertiesofwater,Waterasuniversalsolvent,Acids,bases and salts, pH and buffers.	
Unit-IV	**12Lectures**
Biomolecules: Introduction and occurrence, classification, properties, importance of carbohydrate,lipids,proteins,aminoacidsandnucleicacidsandvarioustypesofRNA's.	
Unit-V	**14Lectures**
Enzymes:Structure, classificationand function -Activesite.energyofactivation,transition state hypothesis, lock and key hypothesis, induced fit hypothesis. Concept of Km- MichaelisMenten equation. Various types of enzyme inhibition. Introduction to Allosteric Enzymes. Definition of holoenzyme,Apoenzyme.Coenzyme,cofactor,prostheticgroupandtheirexamples.Conceptof ribozyme.	

BOOKS:

1. PrinciplesofBiochemistryLehninger,Nelson&Cox.
2. Biochemistry,Voet&Voet
3. Biochemistry,Berg&Stryer
4. TextbookofBiochemistry,S.P.Singh
5. MolecularBiologyoftheCell,BruceAlberd
6. TextbookofBiochemistry,U.Satyanarayana
7. ExperimentsinBiotechnology:NighojkarandNighojkar

BIOTECHNOLOGY-IIIPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. PrinciplesandworkingknowledgeofinstrumentslikeColorimeter,pH meter,Centrifuge,Spectrophotometer,Microscopeetc.
2. QualitativeanalysisofCarbohydrates,ProteinsandLipids.
3. QuantitativeestimationofProteinbyFolin-Lowrymethod.
4. QuantitativeestimationofsugarbyNelsonSmogyi'smethod.
5. Determinationofenzymeactivitybyamylase.
6. StudytheeffectofpHonenzymeactivity.
7. Studytheeffectoftemperatureonenzymeactivity.
8. SeparationofaminoacidsbyTLC
9. SeparationofleafpigmentsbyPaperchromatography.
10. Estimationofhemoglobin.
11. RBCcountingbyhaematocytometer.
12. WBCcountingbyDifferential/ortotalcellcount.
13. Measurementofbleedingandclottingtime.

CourseOutcomesofBiophysicsandBiochemistry

Uponsuccessfulcompletionofthe**Biophysicsand Biochemistry**course,studentswillbeable to:

BiophysicsOutcomes:

1. **UnderstandthePhysicalPrinciplesGoverning BiologicalSystems**
   - Explaintheapplicationofphysicsconcepts(thermodynamics,fluiddynamics,andelectromagnetism)in biological processes.
2. **AnalyzeBiomolecularStructuresand Interactions**
   - Understandtheprinciplesofmolecularinteractions,includingproteinfolding, enzymekinetics,andligand binding.
3. **Explain BiomechanicsandBioenergetics**
   - Describethephysicalforcesinvolvedinmusclecontraction,cell motility,andenergytransformationin biological systems.

BiochemistryOutcomes:

6. **ExplainBiomolecularStructureandFunction**
   - Describethechemicalproperties,structure,andbiologicalrolesofproteins,nucleicacids,carbohydrates, and lipids.
7. **UnderstandEnzymeMechanismsandMetabolism**
   - Explainenzymekinetics,catalyticmechanisms,andmetabolicpathways,includingglycolysis,TCAcycle, and oxidative phosphorylation.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	2	0	1	0
CO2	0	1	0	2	0	3	0	3	3	3
CO3	3	2	1	0	3	0	2	1	0	2
CO4	0	1	2	2	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	0	2	1

BSC-302–EnvironmentalStudies-I

MAX.MARKS:50

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofEnvironmentalScience

The**EnvironmentalScience**courseaimstoprovidestudentswithacomprehensiveunderstandingofthe environment, ecological processes, and human impact on natural systems. The key objectives include:

1. **UnderstandtheFundamentalsofEnvironmentalScience**
   - Learnthebasicprinciples,scope,andimportanceofenvironmentalscienceinsustainabilityand conservation.
2. **ExploreEcosystemStructureand Function**
   - Studyecologicalinteractions,biodiversity,foodchains,andenergyflowinecosystems.
3. **AnalyzeNaturalResourcesand TheirManagement**
   - Understandtheuse,conservation,andsustainablemanagementofair,water,soil,forests,andminerals.
4. **ExamineEnvironmentalPollutionandItsImpact**
   - Studythecauses,effects,andcontrolmeasuresforair,water,soil,andnoisepollution.
5. **UnderstandClimateChangeandGlobalEnvironmentalIssues**
   - Learnaboutgreenhousegases, globalwarming, ozonedepletion,andstrategiesfor climatechange mitigation.

Unit-I **12Lectures**
MultidisciplinarynatureofenvironmentalstudiesDefinition,scopeandimportance.
Unit-II **12Lectures**
NaturalResources:Renewableandnon-renewableresources,Naturalresourcesandassociated problems.a)Forestresources,b)Waterresources,c)Mineralresources, d)Foodresources,e) Energyresourcesf)Landresources.
Unit-III **14Lectures**
Ecosystems:Conceptofanecosystem,Structureandfunctionofanecosystem,Producers,consumersanddecompo sers, Energy flowin the ecosystem.
Unit-IV **12Lectures**
Foodchains,foodwebsandecologicalpyramids.Characteristicfeaturesandfunctionofthefollowing ecosystem: a. Forest ecosystem , b. Grassland ecosystemc. Desert ecosystemd. Aquatic ecosystems
Unit-V **14Lectures**
Biodiversity: - Introduction- definition, genetic, species and ecosystem. Importance of Biodiversity. BiogeographicalclassificationofIndia.Indiaasamega-diversitynation.Hot-sportsofbiodiversity.Threats tobiodiversity,EndangeredandendemicspeciesofIndia.Conservationofbiodiversity:In-situandEx-situconservationofbiodiversity

Books:

1. Basu,M.andXavier,S.,FundamentalsofEnvironmentalStudies,CambridgeUniversity Press,2016.
2. Mitra,A.KandChakraborty,R.,IntroductiontoEnvironmentalStudies,BookSyndicate,2016.
3. Enger,E.andSmith,B.,EnvironmentalScience:AStudyofInterrelationships,Publisher: McGraw-Hill HigherEducation;12th edition,2010

CourseOutcomesofEnvironmentalScience(EVS)

Uponsuccessfulcompletionofthe**EnvironmentalScience**course,students willbeable to:

1. **UnderstandEnvironmentalConceptsandEcosystemFunctions**
   - Explainthefundamentalprinciplesofenvironmentalscience,ecosystemdynamics,andbiodiversity conservation.
2. **AnalyzeNaturalResourcesand TheirSustainableUse**
   - Demonstrateknowledgeofresourcemanagementstrategiesforwater,air,soil,forests,andminerals.
3. **EvaluateEnvironmentalPollutionandItsControlMeasures**
   - Identifydifferenttypesofpollution,theirsources,andeffectivesolutionsforenvironmentalprotection.
4. **UnderstandClimateChangeandGlobalEnvironmentalIssues**
   - Analyzethecausesandimpactsofclimatechange,globalwarming,ozonedepletion, andbiodiversityloss.
5. **ApplyWasteManagementandSustainablePractices**
   - Implementconceptsofwastereduction,recycling,andproperdisposalmethodstopromotesustainability.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	2	0	1	0
CO2	2	1	0	2	0	3	0	3	3	2
CO3	0	1	1	1	3	0	2	1	0	2
CO4	0	1	2	1	1	1	0	0	3	0
CO5	3	0	0	1	0	2	1	0	1	1

BSC-303–ENTREPRENEURSHIPDEVELOPMENT-I

MAX.MARKS:50

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofEntrepreneurship

The**Entrepreneurship**courseaimstoequipstudentswiththeknowledge, skills,and mindset requiredtostart, manage, and grow a successful business. The key objectives include:

1. **UnderstandtheFundamentalsofEntrepreneurship**
   - Learnthedefinition,scope,andimportanceofentrepreneurshipineconomicdevelopment.
2. **ExploreEntrepreneurialMindsetandCharacteristics**
   - Developcreativity,innovation,risk-takingability,andproblem-solvingskillsessentialforentrepreneurs.
3. **IdentifyBusinessOpportunitiesandMarket Research**
   - Learnhowtoanalyzemarkettrends,identifybusinessopportunities,andconductfeasibilitystudies.
4. **UnderstandBusinessPlanningandStrategy**
   - Developabusiness model,draftabusinessplan,andformulatestrategiesforbusinesssuccess.
5. **Learn AboutFundingandFinancialManagement**
   - Understandsourcesoffunding,financialplanning,budgeting,andresourcemanagementforstartups.
6. **ExploreLegaland EthicalAspectsofEntrepreneurship**
   - Gainknowledgeofbusinesslaws,taxation,intellectualpropertyrights,andethicalbusiness practices.

08Lectures
Entrepreneurship Development — Concept and importance , Function of Enterprisar ,Goal determination - Problems Challenges and solutions. Project Proposal — need andObjects — Nature of organisation, Production Management, Financial Management , Marketing Management , Consumer Management . Role ofregulatory InstitutionsRoleof developmentorganisations,selfemploymentorientedschemes.MajorMotivesInfluencing anEntrepreneur–AchievementMotivationTraining,SelfRating,Business Games.

TEXTBOOKS:

DonaldFKuratko,

1. "Entrepreneurship–Theory,ProcessandPractice",9thEdition,CengageLearning, 2014.

Khanka.S.S.,

2. "EntrepreneurialDevelopment"S.Chand&Co.Ltd.,RamNagar,NewDelhi,2013

CourseOutcomesofEntrepreneurship

Uponsuccessfulcompletionofthe**Entrepreneurship**course,studentswillbeable to:

1. **DemonstrateanUnderstandingofEntrepreneurship Concepts**
   - Explaintheroleofentrepreneurshipineconomicgrowthandbusinessdevelopment.
2. **DevelopanEntrepreneurialMindset**
   - Applycreativity,innovation,risk-taking,andproblem-solvingskillsinbusinessdecision-making.
3. **IdentifyandEvaluateBusinessOpportunities**
   - Conductmarketresearchandfeasibilityanalysistoidentifypotentialbusinessventures.
4. **CreateaBusinessPlanand Strategy**
   - Developastructuredbusinessplan,includingfinancialprojections,marketingstrategies,andoperational plans.
5. **Understand FinancialandFundingAspects**
   - Identifysourcesoffunding,managefinancialresources,andcreateeffectivefinancialstrategiesfor startups.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	1	2	1	0	1	0
CO2	1	1	0	2	0	3	0	3	2	2
CO3	0	2	0	1	3	0	2	1	0	2
CO4	0	1	2	2	1	2	1	0	2	0
CO5	1	0	1	1	0	1	1	0	1	1

BSC-401–BIOTECHNOLOGY-IV

BIOINSTRUMENTATION,BIOSTATISTICSANDBIOINFORMATIES

MAX.MARKS:40+10
No.ofLecturesperWeek:02Hours
TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

CourseObjectivesofBiostatisticsandBioinformatics

The**BiostatisticsandBioinformatics**courseaimsto providestudentswitha fundamentalunderstandingof statisticalmethods and computational tools used in biologicaland biomedicalresearch. The keyobjectives include:

BiostatisticsObjectives:

1. **UnderstandtheBasicsofBiostatistics**
   - Learnstatisticalconcepts,datatypes,andtheirapplicationsinbiologicalresearch.
2. **DevelopSkillsin Data Collectionand Analysis**
   - Understandexperimentaldesign,samplingmethods,anddatainterpretationinlifesciences.
3. **ApplyDescriptiveandInferentialStatisticalMethods**
   - Learnmeasuresofcentraltendency,dispersion,hypothesistesting,andprobabilitydistributions.

BioinformaticsObjectives:

6. **Understand thePrinciplesofBioinformatics**
   - Learntheroleofbioinformaticsingenomics,proteomics,andsystems biology.
7. **AnalyzeBiologicalDatabasesand SequenceAlignment**
   - StudyDNA, RNA, andproteinsequenceanalysis usingtoolslikeBLAST,FASTA,andmultiplesequence alignment.
8. **LearnComputationalMethodsforGeneand ProteinAnalysis**
   - Understandphylogeneticanalysis,motifdiscovery,andstructuralbioinformaticsapplications.

Unit-I	**14Lectures**
Microscopy—Light,Phasecontrast,fluorescenceandElectronmicroscopy.Centrifugationtechnique. Principlestypes&separationof biologicalmolecules.	
Unit-II	**12Lectures**
ChromatographyandElectrophoresis Chromatography:Principlesandapplications,Principleandapplicationofelectrophoresis. Agarosegelelectrophoresis.Blotting:Southern,WesternandNorthernBlotting.	
Unit-III	**10Lectures**
Spectrophotometry-PrincipleandApplicationUVandVisibleSpectrophotometry,ColorimetryRadio and Non radio labeling, Autoradiography	
Unit-IV	**12Lectures**
Biostatistics-Introduction,Scope,applicationanduseofstatisticcollectionandclassificationofdata summarizationandpresentationofdata.Arithmeticmean,median,standarddeviation. Probability,definition.Randomvariableanditsdistribution.Binomialprobabilitydistribution.	
Unit-V	**16Lectures**
BasicBioinformatics:IntroductiontoInternet,SearchEngines(Google,Yahoo,Entrez/etc) **BiologicalDatabases:**Sequencedatabases(EMBL.GenBank,DDBJ.UNIPROT.TrEMBL).	

BOOKS:

1. BioinformaticsC.V.S.Murthy
2. ThetextbookofBioinformatics,Sharma,MunjalAndShankar
3. BasicBioinformatics,S.Ignacimuthu,S.J.
4. Biostatistics,B.Prasad
5. Biostatistics,P.NArora

CourseOutcomesofBiostatisticsandBioinformatics

Uponsuccessfulcompletionofthe**BiostatisticsandBioinformatics**course,studentswillbeable to:

BiostatisticsOutcomes:

1. **UnderstandandApply BasicStatisticalConcepts**
   - Explainkeystatisticalprinciplesandtheirrelevanceinbiologicalandmedicalresearch.
2. **PerformDataCollectionandExperimentalDesign**
   - Designexperiments,collectbiologicaldata,andapplyappropriatestatisticalmethodsforanalysis.
3. **ApplyDescriptiveandInferentialStatisticalMethods**
   - Usemeasuresofcentraltendency,variability,probabilitydistributions,hypothesistesting,andconfidence intervals in biological studies.
   - Conductcorrelationandregressionanalysistostudyrelationshipsinbiologicaldatasets.

BioinformaticsOutcomes:

6. **UnderstandtheFundamentalsofBioinformatics**
   - Explaintheimportanceofcomputationaltoolsingenomics, proteomics,andsystemsbiology.
7. **UseBiologicalDatabases forSequenceAnalysis**
   - RetrieveandanalyzegeneticandproteinsequencesusingdatabasessuchasGenBank,UniProt,andEMBL.
8. **PerformSequenceAlignmentandPhylogenetic Analysis**
   - ApplybioinformaticstoolslikeBLAST,ClustalW,andMEGAformolecularsequencecomparisons.
9. **AnalyzeGenomicandProteomicDataUsingComputationalTools**
   - Usesoftwareforgeneprediction, proteinstructuremodeling,andfunctionalannotation.
10. **Apply MachineLearningandAIinBioinformatics**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	2	1	0	2	0	3	0	3	3	3
CO3	2	0	1	3	2	0	0	1	0	2
CO4	0	1	2	1	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	0	2	2

BIOTECHNOLOGY-IVPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. SeparationofaminoacidsbyTLC
2. SeparationofleafpigmentsbyPaperchromatography.
3. Estimationofhemoglobin.
4. RBCcountingbyhaematocytometer.
5. WBCcountingbyDifferential/ortotalcellcount.
6. Measurementofbleedingandclottingtime.
7. MeasurementofHeminCrystals.
8. Estimationofbetacaroteneincarrots.
9. Estimationofascorbicacidinlemonjuice.
10. Determinationofiodinenumberoffatsample.
11. Determinationofphosphoruscontentinplantmaterial(Colorimetricmethod).
12. ComputerInputandOutputdevices
13. PrepareaMarksheetofyourclassSubjects
14. Prepareabarchart,piechartforanalysisofElectionResult.
15. Exercisebasedonpowerpointpresentation.
16. Designapresentationillustratinginsertionofpictures,wordart&clipart
17. UseMSWordtoinsertatableintodocument.
18. ProblembasedonMean,Median,Mode.
19. HardyWeinbergLawappliedonPopulationGenetics.
20. ProblembasedonProbability.
21. ExercisebasedonstandardDeviation.
22. Biologicaldataresourcesanddataretrieval

BSC-402–EnvironmentalStudies-II

MAX.MARKS:50

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofEnvironmentalScience

The**EnvironmentalScience**courseaims toprovidestudents witha comprehensiveunderstandingofthe environment, ecological processes, and human impact on natural systems. The key objectives include:

1. **ExploreWasteManagementandSustainablePractices**
   a. Studysolidwastedisposal,wastewatertreatment, andrecyclingtechniquestopromotesustainability.
2. **AnalyzeEnvironmentalLawsandPolicies**
   a. Understandnationalandinternationalenvironmentallaws,treaties,andpoliciesforenvironmental protection.
3. **ExamineHumanPopulationandEnvironmentalImpact**
   a. Studypopulationgrowth,urbanization,andtheireffectsonnaturalresourcesandecosystems.
4. **UnderstandRenewableEnergy andConservationStrategies**
   a. Explorealternativeenergysourcessuchassolar,wind,andbioenergyforsustainabledevelopment.
5. **ApplyEnvironmentalScienceConceptstoReal-WorldProblems**

Unit-I	**12Lectures**
Environmentalpollution:types,causes,effectsandcontrols;Air,water,soilandnoise pollution.	
Unit-II	**12Lectures**
Climatechange,global warming,ozonelayerdepletion,acidrainandimpactsonhuman communitiesandagriculture.	
Unit-III	**14Lectures**
Solidwaste management:Controlmeasuresofurbanandindustrialwaste,special referencee-waste,Biomedicalwaste.	
Unit-IV	**12Lectures**
HumanPopulationandtheEnvironment:populationgrowth,populationexplosion,FamilyWelfare Programme.	
Unit-V	**14Lectures**
· EnvironmentalLaws:TheEnvironment(Protection)Act,1986;TheAir(Preventionand ControlofPollution)Act,1981;TheWater(PreventionandControlofPollution)Act1974; Forest(Conservation)Act,1980;•ThewildlifeProtectionAct,1972	

Books:

- Basu,M.andXavier,S.,FundamentalsofEnvironmentalStudies,CambridgeUniversity Press, 2016.
- Mitra,A.KandChakraborty,R.,IntroductiontoEnvironmentalStudies,BookSyndicate,2016.
- Enger,E.andSmith,B.,EnvironmentalScience:AStudyofInterrelationships,Publisher: McGraw-Hill HigherEducation;12th edition,2010

CourseOutcomesofEnvironmentalScience(EVS)

Uponsuccessfulcompletionofthe**EnvironmentalScience**course,studentswillbeableto:

1. **UnderstandtheFundamentalsofEnvironmentalScience**
   - Explainkeyenvironmentalconcepts, ecosystems,andtheimportanceofbiodiversityconservation.
2. **AnalyzeNaturalResourcesand TheirSustainableUse**
   - Assesstheutilizationandconservationofresourceslikeair,water,soil,forests,andminerals.
3. **IdentifyandEvaluateEnvironmentalPollution**
   - Recognizesources,impacts,andcontrolmeasuresfor air,water,soil,andnoisepollution.
4. **AssessClimateChange andGlobalEnvironmentalIssues**
   - Understandthecausesandconsequencesofglobalwarming,ozonedepletion,anddeforestation.
5. **ApplyWasteManagementandSustainablePractices**
   - Implementtechniquessuchasrecycling,composting,andwastetreatmentforenvironmentalsustainability.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	0	1	0	2	0	3	0	1	0	1
CO3	2	2	1	1	2	0	1	1	0	2
CO4	2	1	2	1	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	0	1	2

BSC-403–ENTREPRENEURSHIPDEVELOPMENT-II

MAX.MARKS:50

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofEntrepreneurship

The**Entrepreneurship**courseaimstoequipstudentswiththeknowledge,skills,andmindset requiredtostart, manage, and grow a successful business. The key objectives include:

1. **UnderstandtheFundamentalsofEntrepreneurship**
   - Learnthedefinition,scope,andimportanceofentrepreneurshipineconomicdevelopment.
2. **ExploreEntrepreneurialMindsetandCharacteristics**
   - Developcreativity,innovation,risk-takingability,andproblem-solvingskillsessentialforentrepreneurs.
3. **IdentifyBusinessOpportunitiesandMarket Research**
   - Learnhowtoanalyzemarkettrends,identifybusinessopportunities,andconductfeasibilitystudies.
4. **UnderstandBusinessPlanningandStrategy**
   - Developabusiness model,draftabusinessplan,andformulatestrategiesforbusinesssuccess.
5. **LearnAboutFundingandFinancialManagement**

- Need–SourcesofFinance,TermLoans,CapitalStructure,
- FinancialInstitution,FinancialManagementforProject—Financialinstitutionandtheir role,
- Capitalestimationandarrangement.Costandpricedeterminationandaccounting management.
- Problemofenterpreneour—ProblemrelatingCapital,
- ProblemrelatingRegistration,administrationproblemandhowtoovercomefromabove problems.
- SicknessinsmallBusiness–Concept,Magnitude,CausesandConsequences

TEXTBOOKS:

- DonaldFKuratko,“Entrepreneurship–Theory,ProcessandPractice”,9thEdition,Cengage Learning, 2014.

- Khanka.S.S.,“EntrepreneurialDevelopment”S.Chand&Co.Ltd.,RamNagar,NewDelhi, 2013.

CourseOutcomesofEntrepreneurship

Uponsuccessfulcompletionofthe**Entrepreneurship**course,studentswillbeable to:

1. **DemonstrateanUnderstandingofEntrepreneurship Concepts**
   - Explaintheroleofentrepreneurshipineconomicgrowthandbusinessdevelopment.
2. **DevelopanEntrepreneurialMindset**
   - Applycreativity,innovation,risk-taking,andproblem-solvingskillsinbusinessdecision-making.
3. **IdentifyandEvaluateBusinessOpportunities**
   - Conductmarketresearchandfeasibilityanalysistoidentifypotentialbusinessventures.
4. **CreateaBusinessPlanand Strategy**
   - Developastructuredbusinessplan,includingfinancialprojections,marketingstrategies,andoperational plans.
5. **Understand FinancialandFundingAspects**
   - Identifysourcesoffunding,managefinancialresources,andcreateeffectivefinancialstrategiesfor startups.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	0	3	0	2	2	2	0	1	0
CO2	1	1	0	2	0	1	0	3	2	3
CO3	2	0	1	1	3	0	2	1	0	2
CO4	0	1	2	0	1	1	1	0	2	0
CO5	1	0	1	1	0	2	2	0	1	0

BSC-501–BIOTECHNOLOGY-V:
MOLECULARBIOLOGYANDGENETICENGINEERING

MAX.MARKS:40+10

No.ofLecturesperWeek:02Hours
TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

CourseObjectivesofMolecularBiology

The**MolecularBiology**courseaimstoprovidestudentswithadeepunderstandingofthemolecularmechanisms that govern cellular processes, gene regulation, and biomolecular interactions. The key objectives include:

1. **Understand theMolecularBasisofLife**
   - LearnthestructureandfunctionofDNA, RNA,andproteinsandtheirrolesincellularprocesses.
2. **ExploreDNAReplication,Repair, andRecombination**
   - StudythemolecularmechanismsofDNAreplication,mutationrepairpathways,andgeneticrecombination.
3. **UnderstandGeneExpressionandRegulation**
   - Analyzetheprocessesoftranscription,translation,andpost-transcriptionalmodificationsinprokaryotes and eukaryotes.
4. **ExamineMolecularMechanismsofGeneticControl**
   - Exploreepigeneticmodifications, operonsystems,andregulatoryproteinsinvolvedingeneexpression.
5. **AnalyzeProteinSynthesisandPost-TranslationalModifications**
   - Studythemolecularmachineryofribosomes,tRNA,andproteinfoldingpathways.

Unit-I	**12Lectures**
DNA and RNA, Chemical Structure, Types and Properties, Experimental Proof of DNA asgenetic material. DNAReplication. Types, Experimental proof of semi conservativereplication, Replicon-Concept. Proteinsand enzymesinvolvedinreplicationin prokaryotesand eukaryotcs,Modes of DNA replication.Unidirectional,Bidirectional,TypesofDNAreplication.Yshaped, rollingcirclemechanism.	
Unit-II	**12Lectures**
Eukaryoticchromosomalorganization,Euebromatin,Heterochromatin.Chromatinstructure. Nucleosomes,histoneandnon-histoneproteins,histonemodifications.	
Unit-III	**14Lectures**
Originof life: Classical experimentsandcurrentconcepts.Evolutionof biological macromolecules,Evolutionofearlyforms,Mendeiangenetics:Mendel'sLaw,Chromosomal basisofheredity,Chromosomalanalysis,allelicvariation, dominance.Linkageandcrossing over.	
Unit-IV	**12Lectures**
IntroductiontoRecombinantDNAtechnology,Scope&importance.GenecloningusingPCR, IntroductiontoRestrictionendonuclease,DNAtransfertechniques,Vectorsandtheirtypes: Plasmids,Phagemids,Cosmids	
Unit-V	**14Lectures**
PlasmidsTypesPropertiesandcloningvectors. Mutation,Typesof mutations; Pointmutation (Basepairchange,frameshift.deletion).Transcription,translationinprokaryotesand eukaryotes.OperonConcept(lacandtryp).	

BOOKS:

- MolecularBiologyofthecell,2002:Albert'setal
- Thecell:Amolecularapproach:J.M.Cooper
- Cellbiology:P.S.VermaandV.K.Agarval
- CellandMolecularBiology:P.K.Gupta
- ExperimentsinBiotechnology:NighojkarandNighojkar
- ApracticalbookofMolecularBiologyandImmunology;2017:P.K.Singh*et*al

CourseOutcomesofMolecularBiology

UponsuccessfulcompletionoftheMolecularBiologycourse,studentswillbe able to:

1. **UnderstandtheStructureandFunction ofBiomolecules**
   - ExplaintherolesofDNA,RNA,andproteinsincellularandmolecularprocesses.
2. **AnalyzeDNAReplication,Repair,andRecombinationMechanisms**
   - DescribethemolecularmechanismsofDNAsynthesis,mutationrepair,andgeneticrecombination.
3. **ExplainGeneExpressionandRegulation**
   - Understandtranscription,translation, andregulatorypathwayscontrollinggeneexpressioninprokaryotic and eukaryotic cells.
4. **ExploreMolecularMechanismsofGeneticControl**
   - Analyzeepigeneticmodifications,operonsystems,andgenesilencingmechanisms.
5. **UnderstandProteinSynthesisandPost-TranslationalModifications**
   - Describethefunctionofribosomes,tRNA,chaperones,andprotein-foldingpathways.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	2	3	2	3	0	1	0
CO2	2	1	0	2	0	3	0	3	3	3
CO3	1	0	1	0	1	0	2	1	0	2
CO4	0	1	2	0	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	2	2	1

BIOTECHNOLOGY-VPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. ChromosomalDNAisolationfromPlantcells.
2. ChromosomalDNAisolationfromAnimalcells.
3. GenomicDNAisolationfromMicro-Organisms.
4. AnalysisofisolatedDNAbyAgarosegelelectrophoresis.
5. SpectrophotometricanalysisofDNAandDNAmelting.
6. UVasaphysicalmutagen
7. GradientPlateTechnique
8. EstimationofDNAusingdiphenylaminemethod.
9. EstimationofRNAusingorcinolmethod.
10. IsolationofRNAfromYeast.
11. IsolationofplasmidDNAfrombacteria.
12. EffectofUVradiationonmicrobialcell
13. Demonstrationofrepairmechanism*in*microbes.
14. Bacteriophage**and**determinationoflatentperiodofinfection
15. IsolationoftotalRNAfromPlanttissuebySDSphenolmethod.
16. ElutionofDNAfromagarosegelband.
17. TransformationinE-colicell.
18. Growthofplanttissueintoundifferentiatedmassofcallus.
19. Preparationofanimalcellculturemedia.
20. Separationandcultureoflymphocytefromblood.
21. Demonstrationoffermentor.
22. Preparationofwine.
23. Extractionofcitricacidfrom*A.spergilluv.*
24. Productionofethanolbyyeast.
25. DemonstrationofPCR.

BSC-502–BIOTECHNOLOGYFORFORENSICSSCIENCE

MAX.MARKS:50

No.ofLecturesperWeek:02Hours
TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternal Choice will be given in all Questions.

CourseObjectivesofForensicScience

The**ForensicScience**courseaimstoprovidestudentswitha fundamentalunderstandingofscientificprinciples and techniques used in crime investigation and legal proceedings. The key objectives include:

1. **UnderstandtheBasicsofForensicScience**
   - Learnthehistory,scope, andsignificanceofforensicscienceincriminalinvestigations.
2. **ExploreCrimeSceneInvestigationTechniques**
   - Studyproceduresforcrimescenedocumentation,evidencecollection,andpreservation.
3. **AnalyzePhysicaland BiologicalEvidence**
   - Learntechniquesforanalyzingfingerprints,bloodstains,DNA,hair,fibers,andothertraceevidence.
4. **UnderstandForensicToxicologyandDrugAnalysis**
   - Studythedetectionandeffectsofdrugs,poisons,andalcoholincriminalcases.
5. **LearnForensicDNAProfilingandGeneticAnalysis**
   - UnderstandtheroleofDNAsequencing,PCR,andSTRanalysis inidentifyingindividual

Syllabus

- BasicofForensicScience:Introduction,Definition,need,significationandscope of ForensicScience.
- Principles of Forensic Science, multi professional and multi personal aspects of forensicscience.
- DomainsinForensicScience:Forensic**Biology**,ForensicMedicine,ForensicToxicology, Forensic Osteology and Odontology, Forensic Anthropology, Wild life Forensic, DNA profiling, Computer Forensicetc.
- EthicalissueinForensicScience
- OrganizationsetupofForensicScienceLaboratory

CourseOutcomesofForensicScience

Uponsuccessfulcompletionofthe**ForensicScience**course,studentswill beable to:

1. **DemonstrateanUnderstanding ofForensicSciencePrinciples**
   - Explaintherole, history, andsignificanceofforensicscienceincriminalinvestigations andthelegal system.
2. **ApplyCrimeSceneInvestigationTechniques**
   - Utilizepropermethodsforcrimescenedocumentation,evidencecollection,andpreservation.
3. **AnalyzePhysicaland BiologicalEvidence**
   - Identifyandinterpretfingerprints,bloodstains,DNA,hair,andfiberevidenceusingforensictechniques.
4. **ExamineForensicToxicologyandDrugAnalysis**
   - Detectandanalyzedrugs, poisons, andtoxinsinbiologicalsamples.
5. **UtilizeDNAProfiling forIdentification**
   - Applymolecular biologytechniquessuchasPCRandSTRanalysisfor forensicidentification.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	1	1	0	2	0	3	0	3	2	3
CO3	2	0	1	1	3	0	2	1	0	2
CO4	0	1	2	0	1	1	1	0	2	0
CO5	1	0	1	1	0	2	1	0	1	1

BSC-503–IntellectualPropertyRights

MAX.MARKS:50

No.ofLecturesperWeek:02Hours
TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoicewill be given in all Questions.

CourseObjectivesofIntellectualPropertyRights(IPR)

The**IntellectualPropertyRights(IPR)** courseaimstoprovidestudentswithacomprehensiveunderstandingof intellectualproperty laws, their significance, and their application in various fields. The key objectives include:

1. **UnderstandtheFundamentalsofIntellectualProperty(IP)**
   - Learntheconcept,history,andimportanceofintellectualpropertyrightsininnovationandbusiness.
2. **ExploreDifferent TypesofIntellectualProperty**
   - Studypatents,copyrights,trademarks,tradesecrets,geographicalindications,andindustrialdesigns.
3. **ExaminePatent LawsandFiling Procedures**
   - Understandtheprocessofpatentapplication,examination,andgrantatnationalandinternationallevels.
4. **AnalyzeCopyright LawsandProtectionMechanisms**
   - Learnaboutcopyrightpolicies,fairuse,andprotectionofliterary,artistic,anddigitalworks.
5. **UnderstandTrademarkRegistration andBrand Protection**
   - Explorethesignificanceoftrademarks,theirregistrationprocess,andinfringementissues.

- IntroductiontoIntellectualProperty,Copyright,RelatedRights,
- TypesofIntellectualPropertyandlegislationscoveringIPRinIndia:-Patents,Copyrights, Trademark.
- IndustrialdesignandTradesecrets.
- ProtectionofplantvarietiesandFarmers'RightAct,Methodsofprotectionofplant and plant products,
- Essentialitiesofplantprotection.
- ClassificationofpatentsbyWIPO,CategoriesofPatentSpecialPatents,Patenting Biological products

CourseOutcomesofIntellectualPropertyRights(IPR)

Uponsuccessfulcompletionofthe**IntellectualProperty Rights(IPR)**course,studentswill beableto:

1. **DemonstrateanUnderstandingofIntellectualProperty(IP)Concepts**
   - ExplainthesignificanceofIPRinprotectinginnovations, creativity,andbusinessassets.
2. **DifferentiateVariousTypesofIntellectual Property**
   - Identifyanddescribepatents,copyrights,trademarks,tradesecrets,geographicalindications,andindustrial designs.
3. **ApplyPatent Lawsand FilingProcedures**
   - Understandtheprocessofpatentfiling,examination, grant,andmaintenanceatnationalandinternational levels.
4. **AnalyzeCopyrightProtection andFairUsePolicies**
   - Explainthelegalaspectsofcopyrightprotectioninliterary,artistic,anddigitalworks.
5. **UnderstandTrademarkLawsand Brand ProtectionStrategies**
   - Evaluatetheimportanceoftrademarks andtheirroleinbrandidentityandbusiness growth.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	0	3	0	2	2	3	0	1	0
CO2	3	1	0	2	0	3	0	2	3	3
CO3	2	2	1	1	3	0	2	1	0	2
CO4	0	1	2	0	1	1	1	0	2	0
CO5	1	0	1	1	0	0	1	0	1	0

BSC-601–BIOTECHNOLOGY-VI

APPLIEDBIOTECHNOLOGY

MAX.MARKS:40+10

No.ofLecturesperWeek:02Hours

TheQuestionPaperwillcontainquestionsequallydistributedinallUnits.TheInternalChoice will be given in all Questions.

CourseObjectivesofAppliedBiotechnology

1. **UnderstandtheFundamentalsofBiotechnology**
   - Learnthebasicconcepts, tools,andtechniquesusedinmodernbiotechnology.
2. **ExploreGeneticEngineering andRecombinantDNA Technology**
   - Studygenecloning,vectorsystems,geneexpression,andCRISPR-basedgenomeediting.
3. **AnalyzeApplicationsofBiotechnology inHealthcare**
   - Understandthedevelopmentofbiopharmaceuticals,genetherapy,vaccines,andpersonalizedmedicine.
4. **ExamineAgriculturalBiotechnologyandCropImprovement**
   - Learnaboutgeneticallymodifiedorganisms(GMOs),biofertilizers,andpest-resistantcrops.
5. **StudyIndustrialBiotechnologyandBioprocessingTechniques**

Unit-I	**14Lectures**
FoodMicrobiology-Microbialcontamination&Spoilage,Foodpreservation.IndustrialProductionof Penicillin..	
Unit-II	**12Lectures**
Introductiontoplanttissueculture,Nutritionalrequirements,In vitroculture.Singlecellculture, Antherculture,Ovuleculture,Somaticembryogenesis,OrganogenesisProtoplastculture,Somatic hybridization, Genetic manipulation of plants using Agrobacterium tumefaciens	
Unit-III	**10Lectures**
Immunity- Innate and Acquired, Cells of Immune system, Vaccines and its types .Antigens-Propertiesandtypes. Immunoglobulin-Structure,typesand functions.,PrimaryandSecondary response, HistoryEquipmentandmaterialsforanimalcellculturetechnology. Physicalrequirementfor animal cell and their growth curve inculture. . Applications of animal biotechnology: Methods of Transfection and cell fusion of animal cells, Selectablemarkers,HATselection,Transgenicanimals,Stemcellculture.,Bioreactorsforlargescale production of animal cells.	
Unit-IV	**12Lectures**
FermentationTechnology,Primaryand Secondary.ScreeningandStrainImprovement. Industrial Sterilization process, Scale-up and Harvest andRecovery. Typesoffermentation— batch,continuousandfed batchprocess.Basicdesignofafermenterand factors affecting fermentation, design.Types offermenters.	
Unit-V	**16Lectures**
Environment:Basicconcept,Significance,Environmentalpollution,Assessmentofwaterquality, Treatmentofwaste-water—Primary,secondaryandtertiarytreatment. Biofertilizers - Nitrogenfixers,PSB,Mycorrhizaand VAM	

BOOKS:

1. MolecularBiologyofthecell,2002:Albert'setal
2. Thecell:Amolecularapproach:J.M.Cooper
3. Cellbiology:P.S.VermaandV.K.Agarval
4. CellandMolecularBiology:P.K.Gupta
5. ExperimentsinBiotechnology:NighojkarandNighojkar
6. ApracticalbookofMolecularBiologyandImmunology;2017:P.K.Singh*et*al

CourseOutcomesofAppliedBiotechnology

Uponsuccessfulcompletionofthe**AppliedBiotechnology**course,studentswillbe ableto:

1. **DemonstrateanUnderstanding ofBiotechnologyPrinciples**
   - Explainthefundamentalconceptsandapplicationsofbiotechnologyinvariousfields.
2. **ApplyGeneticEngineeringandRecombinantDNATechnology**
   - Utilizegenecloning,vectorsystems,andgenomeeditingtechniqueslikeCRISPRforbiotechnological advancements.
3. **AnalyzetheRoleofBiotechnology in Healthcare**
   - Evaluatethedevelopmentandapplicationofbiopharmaceuticals, vaccines,genetherapy,andmolecular diagnostics.
4. **UtilizeBiotechnologyforAgriculturalImprovement**
   - Explainthebenefitsofgeneticallymodifiedorganisms(GMOs),biofertilizers,andpest-resistantcrops.
5. **ImplementIndustrialBiotechnologyandBioprocessingTechniques**
   - Applyfermentation,enzymeengineering,andbiomanufacturingtechniquesforindustrialapplications.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	0	3	0	2	2	3	0	1	0
CO2	2	1	0	2	0	3	0	2	3	3
CO3	1	2	1	1	1	0	2	1	0	2
CO4	0	1	2	1	2	1	1	0	2	2
CO5	2	0	1	1	0	2	1	0	1	0

BIOTECHNOLOGY-VIPRACTICALS

MAX.MARKS:50

No.ofLaboratoryperWeek:06Hours

1. EffectofUVradiationonmicrobialcell
2. Demonstrationofrepairmechanism*in*microbes.
3. Bacteriophage**and**determinationoflatentperiodofinfection
4. ElutionofDNAfromagarosegelband.
5. TransformationinE-colicell.
6. GrowthofplanttissueintoundifferentiatedmassofcallUs.
7. Preparationofanimalcellculturemedia.
8. Separationandcultureoflymphocytefromblood.
9. Demonstrationoffermenter.
10. Preparationofwine.
11. DemonstrationofPCR.

BSC-201:INFORMATIONTECHNOLOGYANDAPPLICATION

IntroductiontoComputers

Introduction, Characteristics of computers, Evolution of computers, Generation of Computers, ClassificationofComputers,TheComputerSystem,ApplicationsofComputers.

Input/OutputdevicesandMemory

Introduction, Keyboard, Pointing Devices, Speech Recognition, Digital Camera, Scanners, Optical Scanners.ClassificationofOutput,Printers,Plotters,ComputerOutputMicrofilm (COM), Monitors, Audio Output, Projectors. Random Access Memory(RAM), Types ofRAM,Read Only Memory(ROM),TypesofROM.ClassificationofSecondaryStorageDevices.

SoftwareConcepts

Introduction to Software, Relationship between Software and Hardware, System Software, ApplicationSoftwareanditstypes,UtilitySoftware,Algorithm,Flowchart,Program,and Pseudocode(P-Code).FeaturesofaGoodProgrammingLanguage.

DataCommunicationandComputerNetwork

Introduction, Data Communication, Transmission Media, Multiplexing, Switching, Computer Network,NetworkTopologies,CommunicationProtocols,Networkdevices.

WorldWideWeb,Hypertext,UniformResourceLocator,WebBrowsers,IPAddress,DomainName, Internet Services Providers, Internet Security,Internet Requirements, Web Search Engine, Net Surfing, InternetServices

MS-Office–MS-Word,MS-Excel,Ms-PowerPoint.

TextBooks:

1. V.Rajaraman,FundamentalsOfComputers,3rdEdition,PHIPublications
2. NasibS.Gill,EssentialsofComputer&NetworkTechnology,KhannaPublications.
3. DeepakBharihoke,FundamentalsofInformationTechnology,ExcelBooks.

ReferenceBook:

1. RajaramanV.–FundamentalofComputers,PrenticeHallofIndiaPvt.Ltd.,NewDelhi–2nd edition,1996.

BSC-202:PROGRAMMINGINC

Fundamentals of C: History of Programming language. Identifier and keywords - data types - constants-Variables-Declarations-Expressions-Statements-Arithmetic,Unary,Relational andlogical,AssignmentandConditionalOperators-Libraryfunctions.SimpleCprograms- Flowofcontrol-if,if-else,while,do-while,forloop,Nestedcontrolstructures-Switch,break and continue, goto statements-Commaoperator.

Functions-Definition-prototypes–types-Passingarguments–Recursionanditstypes-Storage Classes-Automatic,External,Static,GlobalandRegisterVariables.

Arrays-DefiningandProcessing -Passingarraystofunctions -Multi-dimensionarrays-Arraysand Strings.

Structuresandunions-Userdefineddatatypes-Passingstructurestofunctions-Self-referentialstructures- Unions - Bit wise operations.

Pointers-Declarations-PassingpointerstoFunctions-OperationonPointers-PointerandArrays.

Files:FileHandlinginCUsingFilePointers,Openafileusingthefunctionfopen(),Closeafileusing thefunctionfclose(),InputandOutputusingfilepointers,CharacterInputand Outputin Files,StringInput/OutputFunctions,FormattedInput/OutputFunctions,Block Input/ OutputFunctions,SequentialVsRandomAccessFiles,PositioningtheFilePointer.

TextBook:

1. E.BalaguruSwamy-ANSICProgrammingLanguage,2ndEdition,PHI,1988.
2. KanetkarY.,LetusC,BPBPub.,NewDelhi,1999.
3. ReemaThareja-ProgramminginC

ReferenceBook:

1. H.Schildt,C:TheCompleteReference,4thEdition,TMHEdition,2000.
2. ByronGotlfried–CProgramming;OxfordUniversityPress

BSC-203:DATASTRUCTUREUSINGC

PrimitiveandCompositeDataTypes,TimeandSpaceComplexityofAlgorithms,StackandPrimitive OperationonStack.Applications-Infix,Postfix,PrefixandRecursion.Queues, Primitive OperationsonQueues,CircularQueue,DeQueueandPriorityQueue.

Linked List: BasicOperation on Linked List, Circular Linked List,Doubly Linked List, Linked RepresentationofStackandQueue,ApplicationofLinkedList.

Trees: Basic Terminology, Binary Trees, Tree Representation as Array and Linked List, Basic OperationonBinaryTree,TraversalofBinaryTree–InOrder,Preorder,PostOrder,Application ofBinaryTree,ThreadedBinaryTree,B-TreeandHeightBalanceTree(AVL).

Sorting&Searching:SequentialSearch,BinarySearch,InsertionSort,SelectionSort,Quick Sort,BubbleSort,HeapSort,andComparisonofSortingMethods.

Graph: Introduction to Graphs, Definition, Terminology, Directed, Undirected, Weighted Graph, Representation of Graphs, Graph Traversal – Depth First and Breadth First, Spanning Trees, MinimumSpanningTrees,ShortestPathAlgorithm.

TextBook:

1. ExpertDataStructurewith‘C’ByR.BPatel(KhannaBookPublishingCo.(P))
2. DatastructureByLipschutz(TataMcGrawHill)
3. DataStructureByYashvantKanitkar(BPB)

ReferenceBook:

1. AnIntroductiontoDataStructureswithApplications,ByJean-PaulTremblay,Paul G.Sarerson (Tata McGrawHill)
2. DataStructureUsingCandC++ByYedidyahlangsam,MosheJ.Augenstein,AroraM. Tenenbaum (Prentice- HallIndia)

BSC-204OBJECTORIENTEDPROGRAMMINGUSINGJAVA

Introductionto java:evolution, features, comparison with C and C++;Javaprogramstructure;tokens, keywords, constants, variables, data types, type casting, statements, Operators and Expression; ConditionalStatementsandLoopStatements.

Class:syntax, instance variable, class variables, methods, constructors, overloading ofconstructors andmethods.Arrays,StringsandVectors.

Inheritance:typesofinheritance,useofsuper,methodoverriding,finalclass,abstractclass,wrapper classes.Interface,Packagesandvisibilitycontrols.

Errors and Exceptions: Types of errors, Exception classes, Exception handling in java, useoftry, catch, finally, throw and throws. Taking user input, Command line arguments.**Multithreaded Programming:**CreatingThreads,Lifecycleofthread,Threadpriority,Threadsynchronization,Inter-threadcommunication,implementingtheRunnableInterface;

Applet: AppletLifeCycle,AppletTag,AddingApplettoHTMLFile;PassingParameterstoApplets, Getting Input From User.**AWT :**AWT Classes, Working With Frame Windows,WorkingWith Graphics,WorkingWith Colour,Adding AndRemoving Controls, Responding To Controls, Labels,Buttons,Checkbox,CheckboxGroup,ChoiceControl,Lists,TextField, TextArea. Menus, Dialog Box, HandlingEvents.

TextBook:

1. Java:ABeginner'sGuide,SixthEdition:ABeginner'sGuidebyHerbert Schildt, McGraw-Hill OsborneMedia
2. ProgramminginJAVAByE.Balagurusamy(TMH)
3. JAVA2programmingBlackBookByStevenHolzneretal.(DreamtechPress)

ReferenceBook:

1. TheCompletereferenceJavaNinthEditionByHerbertSchildt(TataMcGrawHill)
2. CoreJavaVolumeI--Fundamentals(9thEdition)byCayS.Horstmann,GaryCornell, PrenticeHall

BSC-205:DATABASEMANAGEMENTSYSTEM

Introduction: Characteristics of database approach, Advantages, Database system architecture, Overview of different types of Data Models and data independence, Schemas and instances, Databaselanguagesandinterfaces; E-R Model: Entities, Attributes, keys, Relationships, Roles, Dependencies, E-R Diagram.

Introduction to Relational model, Constraints: Domain, Key, Entity integrity, Referentialintegrity; Keys: Primary, Super, Candidate, Foreign; Relational algebra: select, project, union, intersection, crossproduct,differenttypesofjoinoperations.

SQL: Data Types, statements: select, insert, update, delete, create, alter, drop; views, SQL algebraicoperations;Storedprocedures:Advantages,Variables,creatingandcallingprocedures,if and case statements, loops, Functions, Triggers.

Normalization: Definition, Functional dependencies and inference rules, 1NF, 2NF, and 3NF; Transactions processing: Definition, desirable properties of transactions, serial and non-serial schedules,conceptofserializability,conflict-serializableschedules.

ConcurrencyControl:Two-phaselockingtechniques,dealingwithDeadlockandstarvation,deadlock prevention protocols, basic timestamp ordering algorithm; Overview of database recovery techniques;conceptof datawarehousing.

TextBook:

1. DatabaseSystemConceptsByKorth,Silberschatz,Sudarshan(McgrawHill)
2. AnIntroductiontoDatabaseSystemsByBipinC.Desai(GalgotiaPublication.)
3. SQL,PL/SQLProgrammingByIvanBayross(BPB)
4. CommercialApplicationDevelopmentUsingOracleDeveloper2000ByIvanBayross(BPB)

ReferenceBook:

1. FundamentalsofDatabaseSystems,RamezA.Elmasri,ShamkantNavathe,5th Ed(Pearson)

BSC-206:PYTHONPROGRAMMING

OverviewofProgramming:StructureofaPythonProgram,PythonInterpreter,UsingPythonascalculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings,Operators(Arithmetic operator,Relationaloperator,LogicalorBooleanoperator,Assignment,Operator,Ternaryoperator, Bitwiseoperator,IncrementorDecrementoperator).

Creating Python Programs: Input and Output Statements, Control statements (Branching,Looping, Conditional Statement, Exit function, Difference between break, continue), Defining Functions, defaultarguments, ErrorsandExceptions.

IterationandRecursion:Conditional execution, Alternative execution,Nested conditionals,The return statement, Recursion, Stackdiagramsfor recursive functions, Multipleassignment, The while statement, Implementing 2-Dmatrices.

StringsandLists:Stringasacompounddatatype,Length,Traversalandtheforloop,String slices,Stringcomparison,Loopingandcounting,Listvalues,Accessingelements,Listlength, Listmembership,Listsandforloops,Listoperations,Listdeletion.Cloninglists,Nestedlists.

Object Oriented Programming: Introduction to Classes, Objects and Methods, Standard Libraries. Overview of stacks andqueues.

TextBooks:

1. T.Budd,ExploringPython,TMH,1stEd,2011
2. Introductiontocomputationandprogrammingpython,byJohnGuttag,MITPress.
3. LearningPython,LutzandAscher,O'Reillypublications

WebResources:

1. http://files.swaroopch.com/python/byte_of_python.pdf
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://greenteapress.com/thinkpython/thinkpython.pdf
4. Pythonturorials:https://docs.python.org/3/tutorial/index.html

BSC-301–PHARMACHEMISTRY-I

INORGANICCHEMISTRY

Scope:

Thissubjectdealswiththemonographsofinorganicdrugsandpharmaceuticals.General discussion on the following inorganic compounds including important physical and chemical properties,medicinalandpharmaceuticalusesandstorageconditions.

Unit-I

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities,principleinvolvedinthelimittestforChloride,Sulphate,Iron,Arsenic,Leadand Heavy metals, **Acids,BasesandBuffers**:Acid-basetheories,Bufferequationsandbuffercapacityingeneral,buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. Boric acid, Ammonium hydroxide, Hydrochloricacidandofficialbuffers.

UNIT-II

Gastrointestinalagents

Acidifiers:AmmoniumchlorideandDil.HCl

Antacid:Ideal propertiesofantacids, combinationsofantacids, SodiumBicarbonate, Aluminum hydroxide gel, Magnesium hydroxide mixture, Aluminum phosphate, Calcium carbonate, Combinations of antacid preparations.

Cathartics:Magnesiumsulphate,Sodiumpotassiumtartrate

Topicalagents

Antimicrobials& Astringents: Mechanism, classification, Potassium permanganate, Hydrogen peroxide, Chlorinated lime, Iodine and its preparations, Borax, Silver nitrate, Ammoniatedmercury, Mercuricoxide,ZincSulphate,Potash Alum

UNITIII

Majorextraandintracellularelectrolytes

Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride&itspreparation,Potassiumchloride,Calciumgluconate,Sodiumlactateinjection,Potassium citrateandOralRehydrationSalt(ORS),Physiologicalacidbasebalance.

UNITIV

Expectorants&Emetics

Potassiumiodide,Ammoniumchloride,Coppersulphate,Antimonypotassiumtartrate

Haematinics

Ferroussulphate,Ferrousgluconate

PoisonandAntidote

Sodiumthiosulphate,Activatedcharcoal,Sodiumnitrite

UNITV

Radiopharmaceuticals

Radioactivity,Measurementofradioactivity,Propertiesofα,β,γradiations,Halflife,radioisotopes and study of radio isotopes - Sodium iodide I131 , Storage conditions, precautions& pharmaceutical applicationofradioactivesubstances.Radioopaquecontrastmedia-Barium sulfate.

PRACTICAL

1. LimittestforChloride,Sulfate,Arsenic,IronandHeavymetals.
2. Identificationtestsforinorganiccompoundsparticularlydrugsandpharmaceuticals.
3. EstimationofFe(II)ionsbytitratingitwithK2Cr2O7.
4. EstimationofCu(II)ionsiodometricallyusingNa2S2O3.
5. Estimationofsodiumcarbonateandsodiumbicarbonatepresentinamixture.

RecommendedBooks

6. Inorganicpharmaceuticalchemistry,Anand&Chatwal.
7. VogelsQuantitativeChemicalAnalysis,A.I.Vogel,PrenticeHall,6thEdition.
8. J.D.Lee:AnewConciseInorganicChemistry,EL.B.S.
9. F.A.Cotton&G.Wilkinson:BasicInorganicChemistry,JohnWiley.
10. Douglas,McDanielandAlexander:ConceptsandModelsinInorganicChemistry,John Wiley

BSC-302–PHARMACHEMISTRY-II

BIO-CHEMISTRY&METABOLISM

Unit-I

Aminoacid&Proteins:StructureandpropertiesofAminoacids,TypesofProteinsandtheir Classification,Forcesstabilizingproteinstructureandshape.Differentlevelsofstructuralorganization ofproteins,Fibrousandglobularproteins.Carbohydrates:Structure,Functionandpropertiesof Monosaccharides,DisaccharidesandPolysaccharides.Homo&Heteropolysaccharides,Muco-polysaccharides,Bacterialcellwallpolysaccharides,Glycoproteinsand their biological functions.

UNIT-II

Lipids:StructureandfunctionsClassification,nomenclatureandpropertiesoffattyacids,essential fatty acids. Phospholipids, Sphingolipids, Glycolipids, Cerebrosides, Gangliosides, Prostaglandins, Cholesterol.

UNIT-III

Nucleicacids:Structureandfunctions:Physical&chemicalpropertiesofNucleicacids,Nucleosides& Nucleotides, Purines&Pyrimidines. Biologically important nucleotides, Doublehelical model of DNAstructureandforcesresponsibleforA,B&ZDNA.

UNIT-IV

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenezyme, prosthetic groups, Enzyme activity, Specific activity, Common feature of activesites, Enzymespecificity.

UNIT-V

Carbohydrates Metabolism: Reactions, energetic and regulation. Glycolysis: Fate of pyruvateunder aerobic and anaerobic conditions. Pentose phosphate pathwayand its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis.TCA cycle, Electron transport chain, Oxidative phosphorylation,Beta-oxidationoffattyacids.

PRACTICAL

1. Tostudyactivitiesofanyenzymeunderoptimumconditions.
2. TostudytheeffectofpH,temperatureontheactivityofsalivaryamylaseenzyme.
3. Determination of pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor(Inorganicphosphate)ontheenzymeactivity.
4. Estimation of blood by glucose oxidase method. item Principles of Colorimetry: (i) VerificationofBeersLambert'slaw,estimationofprotein.(ii)Tostudy relation between absorbance and %transmission.
5. Preparationofbuffers.
6. SeparationofAminoacidsbypaperchromatography.
7. QualitativetestsforCarbohydratesandlipids.
8. Qualitativeestimationofproteins.

RecommendedBooks

1. Nelson,D.L.,Cox,M.M.(2004)LehningerPrinciplesofBiochemistry,4thEdition,WH Freeman and Company, New York,USA.
2. Berg,J.M.,Tymoczko,J.L.andStryer,L.(2006).Biochemistry.VIEdition.W.H Freeman andCo.
3. Harper'sIllustratedBiochemistry(Harper'sBiochemistry)byRobertK.Murray, Darryl K.Granner,PeterA.Mayes,andVictorW.Rodwell.
4. FundamentalsofBiochemistry.Lifeatthemolecularlevel(FourthEdition)byDonaldVoet, Judith G.VoetandCharlotte.W.Pratt.Willey2010.
5. BiophysicalChemistry,Principles&Techniques–Upadhyay,Upadhyay&Nath– HimalayaPubl.
6. Biochemistry,4theditionbyUSatyanarayanaandUChakrapani,ElsevierIndia

BSC-303–PHARMACHEMISTRY-III
ORGANICCHEMISTRY

Unit-I

AtomicStructure

Review of: Bohrs theoryanditslimitations, dual behaviour of matter andradiation, de-Broglies relation,Heisenberg Uncertaintyprinciple.Hydrogenatomspectra.Quantummechanics. Radial and angularpartsofthehydogenicwavefunctions(atomicorbitals)andtheirvariationsfor1s,2s, 2p, 3s,3pand 3d orbitals(Only graphical representation). Significance ofquantum numbers. Spin quantumnumber(s)and magnetic spin quantumnumber(ms).Rulesfor filling electronsin various orbitals,Electronicconfigurationsoftheatoms.Stabilityofhalf-filledandcompletelyfilled orbitals,conceptofexchangeenergy.Relativeenergiesofatomicorbitals.

Unit-

IIChemicalandMolecularStructure

IonicBonding:General characteristicsofionicbonding.Energy considerationsin ionicbonding, lattice energyand solvation energy and their importance in the context of stability and solubilityof ionic compounds.Statement of Born-Land equation for calculation of lattice energy, Born- Haber cycleanditsapplications, polarizingpowerandpolarizability.Fajansrules,ioniccharacter in covalent compounds, dipole moment .Covalent bonding: VB Approach: Shapes of some inorganicmoleculesandionsonthebasis ofVSEPRandhybridization with suitable examplesof linear, trigonalplanar,squareplanar,tetrahedral,trigonalbipyramidalandoctahedral arrangements. Concept of resonance and resonating structures in various inorganic and organiccompounds.

Unit-

IIIFundamentalsofOrganicChemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonanceand Hyperconjugation.CleavageofBonds:HomolysisandHeterolysis.Structure,shapeandreactivityof organicmolecules:Nucleophilesandelectrophiles.ReactiveIntermediates:Carbocations,Carbanions and free radicals. Strength of organic acids and bases.Aromaticity: Huckelsrule.

Unit-

IVStereochemistry

Conformations with respect to ethane, butane andcyclohexane.Fischer representations.Concept of chirality(uptotwocarbonatoms).Configuration:GeometricalandOpticalisomerism;Enantiomerism, DiastereomerismandMesocompounds).DandL;cis-trans nomenclature.Racemicmodification andresolutionofracemicmixture.

Unit-

VAliphaticHydrocarbons

Preparations& reactions Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation,Wurtz reaction,Kolbessynthesis,fromGrignardreagent.Reactions:FreeradicalSubstitution:Halogenation. Alkenes:(Upto5Carbons) Preparation: Elimination reactions:Dehydrationofalkenes and dehydro-halogenation ofalkyl halides (Saytzeffs rule); cis alkenes (Partial catalytic hydrogenation) Birch reduction.Reactions:cis-addition(alk.KMnO4)andtrans-addition(bromine),Markownikoffsandanti-Markownikoffsrule,Hydration,Ozonolysis,Alkynes:(Upto 5Carbons)Preparation:AcetylenefromCaC2andconversionintohigheralkynes;bydehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides,additionofbromineandalkalineKMnO4,ozonolysis.

PRACTICAL

1. Detectionofextraelements(N,S,Cl,Br,I)inorganiccompounds(containinguptotwo extraelements).

2. Experimentsinvolvinglaboratorytechniques-Recrystallization,Steamdistillation.

RecommendedBooks

1. VogelsQualitativeInorganicAnalysis,A.I.Vogel,PrenticeHall,7thEdition.

2. VogelsQuantitativeChemicalAnalysis,A.I.Vogel,PrenticeHall,6thEdition.

3. TextbookofPracticalOrganicChemistry,A.I.Vogel,PrenticeHall,5thedition.

4. PracticalOrganicChemistry,F.G.Mann.&B.C.Saunders,OrientLongman,1960.

BSC-304–PHARMACHEMISTRY-IV

PHARMACEUTICALANALYSIS

Scope

Thiscoursedealswiththefundamentalsofanalyticalchemistryandprinciplesofelectrochemical analysis of drugs.

Unit-I

a) **Pharmaceuticalanalysis:**Definitionandscope
   i) Differenttechniquesofanalysis
   ii) Methodsofexpressingconcentration
   iii) Primaryandsecondarystandards.
   iv) Preparationandstandardizationofvariousmolarandnormalsolutions-Oxalicacid, sodiumhydroxide,hydrochloricacid,sodiumthiosulphate,sulphuricacid,potassium permanganate and ceric ammoniumsulphate
   v) **Errors:**Sourcesoferrors,typesoferrors,methodsofminimizingerrors,accuracy, precision and significantfigures.

UNIT-II

Acidbasetitration

Theoriesofacidbaseindicators,classificationofacidbasetitrationsandtheoryinvolvedintitrationsof strong,weak,andveryweakacidsandbasesneutralizationcurves.

Nonaqueoustitration

Solvents,acidimetryandalkalimetrytitrationand,estimationofSodiumbenzoateandEphedrineHCl

UNIT-III

Complexometrictitration

Classification,metalionindicators,maskinganddemaskingreagents,estimationofMagnesium sulphate, and calcium gluconate.

Gravimetry

Principleandstepsinvolvedingravimetricanalysis. Purityoftheprecipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotization titration

UNIT-IV

Redoxtitrations

(a) Conceptsofoxidationandreduction

(b) Typesofredoxtitrations(Principlesandapplications)Cerimetry,Iodimetry,Iodometry, Bromatometry,Dichrometry,andTitrationwithpotassiumiodate.

UNIT-V

Electrochemicalmethodsofanalysis

Conductometry

Introduction,Conductivitycell,Conductometrictitrations,applications

Potentiometry

Electrochemical cell, construction and working of reference (Standard hydrogen, silver chlorideelectrodeandcalomel electrode)andindicator electrodes(metal electrodesandglass electrode),methodstodetermineendpointofpotentiometrictitrationandapplications.

Polarography

Principle,Ilkovicequation,constructionandworkingofdroppingmercuryelectrodeandrotating platinum electrode, applications.

PRACTICAL

I. Preparationandstandardizationof

(1) Sodiumhydroxide

(2) Sulphuricacid

(3) Sodiumthiosulfate

(4) Potassiumpermanganate

(5) Cericammoniumsulphate

II. AssayofthefollowingcompoundsalongwithStandardizationofTitrant

(1) Ammoniumchloridebyacidbasetitration

(2) FerroussulphatebyCerimetry

(3) CoppersulphatebyIodometry

(4) Calciumgluconatebycomplexometry

(5) HydrogenperoxidebyPermanganometry

RecommendedBooks

1. A.H.Beckett&J.B.Stenlake's,PracticalPharmaceuticalChemistryVolI&II, Stahlone Press of University ofLondon
2. A.I.Vogel,TextBookofQuantitativeInorganicanalysis
3. P.GunduRao,InorganicPharmaceuticalChemistry
4. BentleyandDriver'sTextbookofPharmaceuticalChemistry
5. JohnH.Kennedy,Analyticalchemistryprinciples

BSC-305–PHARMACHEMISTRY-V

PHARMACEUTICALQUALITYASSURANCE

Scope

This course deals with the variousaspects ofquality control and qualityassurance aspects of pharmaceuticalindustries.ItdealswiththeimportantaspectslikecGMP,QCtests,documentation, qualitycertificationsandregulatoryaffairs.

UNIT–I

QualityAssuranceandQualityManagementconcepts

DefinitionandconceptofQualitycontrol,Qualityassuranceand GMP

TotalQualityManagement(TQM)

Definition,elements,philosophies

ICHGuidelines

Purpose,participants,processofharmonization,BriefoverviewofQSEM,withspecial emphasisonQ-seriesguidelines,ICHstabilitytestingguidelines

Qualitybydesign(QbD)

Definition,overview,elementsofQbDprogram,tools

ISO9000&ISO14000

Overview,Benefits,Elements,stepsforregistration

UNIT-II

Organizationandpersonnel

Personnelresponsibilities,training,hygieneandpersonalrecords.

Premises

Design,constructionandplantlayout,maintenance,sanitation,environmentalcontrol,utilities andmaintenanceofsterileareas,controlofcontamination.

Equipmentsandrawmaterials

Equipmentselection,purchasespecifications,maintenance,purchasespecificationsand maintenance of stores for raw materials.

UNIT–III

QualityControl

Qualitycontroltestforcontainers,rubberclosuresandsecondarypackingmaterials.

GoodLaboratoryPractices

General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical LaboratoryStudy, RecordsandReports,DisqualificationofTestingFacilities.

UNIT–IV

Complaints

Complaintsandevaluationofcomplaints,Handlingofreturngood,recallingandwastedisposal.

Documentmaintenanceinpharmaceuticalindustry

Batch Formula Record, Master FormulaRecord, SOP,Qualityaudit,QualityReviewand Qualitydocumentation,Reportsanddocuments,distributionrecords.

UNIT–V

CalibrationandValidation

Introduction, definition and general principles of calibration, qualification and validation, importanceandscopeofvalidation,typesofvalidation,validationmasterplan.Calibrationof pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

RecommendedBooks

1. QualityAssuranceGuidebyorganizationofPharmaceuticalProductsofIndia.
2. GoodLaboratoryPracticeRegulations,2ndEdition,SandyWeinbergVol.69.
3. QualityAssuranceofPharmaceuticals-AcompendiumofGuidelinesandrelated materials Vol I WHOPublications.
4. AguidetoTotalQualityManagement-KushikMaitraandSedhanKGhosh
5. HowtoPracticeGMP's–PPSharma.
6. ISO9000andTotalQualityManagement–SadhankGGhosh.
7. TheInternationalPharmacopoeia–VolI,II,III,IV-GeneralMethodsofAnalysisand Quality specificationforPharmaceuticalSubstances,ExcipientsandDosageforms
8. GoodlaboratoryPractices–MarcelDeckkerSeries
9. ICHguidelines,ISO9000and14000guidelines

BSC-306–PHARMACHEMISTRY-VI

PHARMACEUTICALREGULATORYSCIENCE

Scope

Thiscourseisdesignedtoimpartthefundamentalknowledgeontheregulatory requirements forapprovalofnewdrugs,anddrugproductsinregulatedmarketsofIndia&othercountrieslikeUS, EU,Japan,Australia,UKetc.Itpreparesthestudentstolearnindetailontheregulatoryrequirements,documentation requirements,and registration proceduresformarketingthedrug products.

UnitI

NewDrugDiscoveryanddevelopment Stagesof drugdiscovery, Drugdevelopment process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug productdevelopment.

UnitII

RegulatoryApproval ProcessApproval processesandtimelinesinvolvedinInvestigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application(ANDA). Changesto an approvedNDA /ANDA.

UnitIII

Registration of Indian drug product in overseas market Procedure for export ofpharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD),electronicCommonTechnicalDocument(eCTD),ASEANCommonTechnicalDocument (ACTD)research.

UnitIV

ClinicaltrialsDevelopingclinicaltrialprotocols,InstitutionalReviewBoard /IndependentEthics committee - formationand workingprocedures, Informedconsentprocessandprocedures,GCP obligations of Investigators, sponsors& Monitors, Managing andMonitoring clinical trials, Pharmacovigilance-safetymonitoringinclinicaltrials.

UnitV

RegulatoryConceptsBasicterminology,guidance,guidelines,regulations,LawsandActs,Orange book,FederalRegister,CodeofFederalRegulatory,Purplebook.

RecommendedBooks

1. DrugRegulatoryAffairsbySachinItkar,Dr.N.S.Vyawahare,NiraliPrakashan.
2. ThePharmaceuticalRegulatoryProcess,SecondEditionEditedbyIraR.BerryandRobert P.Martin,DrugsandthePharmaceuticalSciences,Vol.185.InformaHealthcarePublishers.
3. NewDrugApprovalProcess:AcceleratingGlobalRegistrationsByRichardAGuarino,MD, 5thedition,DrugsandthePharmaceuticalSciences,Vol.190.
4. Guidebookfordrugregulatorysubmissions/SandyWeinberg.ByJohnWiley&Sons. Inc.
5. FDARegulatoryAffairs:aguideforprescriptiondrugs,medicaldevices,andbiologics /editedbyDouglasJ.Pisano,DavidMantus.
6. GenericDrugProductDevelopment,SolidOralDosageforms,LeonShargeland IsaderKaufer, Marcel Dekker series,Vol.143
7. ClinicalTrialsandHumanResearch:APracticalGuidetoRegulatoryComplianceByFay A.RozovskyandRodneyK.Adams
8. PrinciplesandPracticesofClinicalResearch,SecondEditionEditedbyJohnI.Gallinand Frederick P.Ognibene
9. Drugs:FromDiscoverytoApproval,SecondEditionByRickNg

CURRICULUMARTICULATEMATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	2	3	1
CO3	2	3	1	1	3	0	2	1	3	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	3	2	1	1	1	1
	1.8	1.8	1.6	1	1.8	1.6	1.6	1.4	2	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	2	2	1	1	1	0	2	2
CO2	2	0	1	1	0	2	2	2	1	1
CO3	3	4	1	2	2	1	3	1	2	2
CO4	1	2	3	1	1	2	1	2	2	1
CO5	2	1	0	3	1	1	0	3	1	1
AVR	1.8	2	1.4	1.8	1	1.4	1.4	1.6	1.6	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	1	1	1	1	0	2	2
CO2	2	1	1	2	1	2	2	1	1	1
CO3	3	3	1	1	1	2	2	2	2	2
CO4	1	1	3	1	0	2	1	2	2	1
CO5	1	1	0	3	2	1	0	3	1	1
AVR	1.6	1.8	1.4	1.6	1	1.6	1.2	1.6	1.6	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	0	2	2	3	0	1	0
CO2	2	2	1	2	0	3	1	2	3	1
CO3	2	3	0	1	3	0	2	1	3	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	3	2	1	1	1	1
	1.8	2.0	1.5	1	1.8	1.6	1.6	1.4	2	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	2	1	0	1	0	2	2
CO2	1	2	1	1	0	1	2	2	2	1

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	0	2	2	3	0	1	0
CO2	3	1	1	2	0	3	1	2	3	1
CO3	2	3	1	1	3	0	2	1	3	2
CO4	1	1	2	1	1	1	1	3	2	3
CO5	1	2	1	1	3	2	1	1	1	1
	1.8	1.8	1.6	1	1.8	1.6	1.6	1.4	2	1.4
CO3	2	1	3	3	2	1	1	1	1	2
CO4	1	1	1	1	1	2	1	2	1	1
CO5	2	1	0	1	1	1	0	3	1	1
AVR	1.4	1.6	1.4	1.6	1	1	1	1.6	1.4	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	1	1	1	1	0	2	2
CO2	1	2	1	1	1	1	2	1	1	1
CO3	3	2	1	2	2	2	2	2	2	2
CO4	1	1	3	1	0	2	1	2	2	1
CO5	1	1	0	3	2	1	0	3	1	1
AVR	1.6	1.4	1.4	1.6	1.2	1.4	1.2	1.6	1.6	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	3	1	2	1	0	1	0	2	2
CO2	1	2	1	1	0	1	2	2	2	1
CO3	2	1	3	3	2	1	1	1	1	2
CO4	1	1	1	1	1	2	1	2	1	1
CO5	2	1	0	1	1	1	0	3	1	1
AVR	1.4	1.6	1.4	1.6	1	1	1	1.6	1.4	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10

CO1	3	1	2	1	1	1	1	0	2	2
CO2	1	2	2	2	1	0	2	1	1	1
CO3	0	1	1	2	2	2	2	2	2	2
CO4	1	1	3	1	0	2	1	2	1	1
CO5	1	1	0	3	2	1	0	2	1	1
AVR	1.2	1.2	1.4	1.8	1.2	1.2	1.2	1.4	1.4	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	3	1	0	1	0	2	2
CO2	3	3	3	1	0	2	2	2	2	2
CO3	1	1	2	3	2	1	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	2	1.6	1.4	2	1.2	1.2	1.2	1.6	1.4	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	3	1	0	1	0	2	2
CO2	3	2	3	2	0	2	2	2	2	2
CO3	1	1	1	3	2	2	2	1	1	1
CO4	1	1	1	2	1	2	1	2	1	1
CO5	2	1	0	1	2	1	0	3	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.4	1.2	1.6	1.4	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	1	2	2	2	2	0	2	1	1	1
CO3	2	2	1	3	2	3	2	2	2	2
CO4	1	1	3	1	0	2	1	2	0	1

CO5	1	1	0	3	2	1	0	2	1	1
AVR	1.6	1.4	1.4	2	1.4	1.4	1.2	1.4	1.2	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	1	1	1	3	2	3	2	2	2	2
CO4	1	2	3	1	3	2	2	2	2	1
CO5	1	1	2	3	2	2	0	2	1	1
AVR	1.6	1.4	1.4	2	2	1.6	1.4	1.4	1.6	1.4

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	2	1	1	1	1	0	2	2
CO2	2	2	2	2	2	0	2	1	1	1
CO3	3	2	0	3	2	3	2	2	2	2
CO4	1	2	3	2	2	2	1	3	2	1
CO5	1	1	2	1	2	2	0	2	1	1
AVR	2	1.6	1.4	1.8	1.8	1.6	1.2	1.6	1.6	1.4

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	1	3	1	0	1	0	2	2
CO2	3	2	3	2	0	2	2	2	2	2
CO3	1	1	2	3	2	2	2	3	2	1
CO4	1	1	1	2	1	1	1	2	1	2
CO5	2	1	0	1	2	1	0	3	1	1
AVR	1.8	1.4	1.4	2.2	1.2	1.2	1.2	2	1.6	1.6