Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Botany
(Three Years- Six Semesters Bachelor's Degree Programme)

Syllabus for : GOEC : ELEMENTARY FORENSIC SCIENCE (106403)

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106403	ELEMENTARY FORENSIC SCIENCE	2	30	2 Hrs	30

Course Objectives:	1. To Learn about significance of Forensic Sciences. 2. To learn about applications of forensic science.			
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Students will be able to **Recognize** importance of Forensic science and it methodology. CO-2: Students will be able to **classify** criminal record by fingerprints. CO-3: Students will **apply** knowledge to understand Criminal psychology CO-4: Students will be able to **categorize** types of evidences at crime location CO-5: students will be able to **plan** strategies for using chromatographic and spectroscopic techniques in processing crime scene evidence. CO-6: Students will be able to **develop** photography and videography for recording the crime scenes.			
Unit System	**Contents**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I	**Introduction to Forensic Science**	8	8	
	1.1 Forensic Science: Definition of Forensic Science, The Role of the Forensic Laboratory, History and Development of Forensic Science in India Multidisciplinary nature, Forensic Technology solving crimes with advanced technology			
	1.2 Forensic Evidences: Concise of Forensic Physical, Biological, Chemical and Psychological evidences, Medico-Legal Cases.			
	1.3 Branches of Forensic Science, Forensic intelligence and Interviews.			
	1.4 Laws and Principles of Forensic Science: Law of Exchange (Locard), Law of Individuality, Law of Comparison, Law of Progressive Changes and Law of Probability, Branches of Forensic Science.			
Unit II0	**GENERAL FORENSIC TOOLS**	7	7	
	2.1 Schematic analysis of Chemical, Biological and Physical samples, Preliminary and Confirmatory methods of analysis, Colour spot tests in Forensic Biological, Chemical and Physical analysis, Microcrystalline test.			
	2.2 Biometrics in Personal Identification: Introduction, Concepts of Biometric Authentication, Role in person Identification, Techniques and Technologies (Finger Print Technology, Face Recognition, IRIS, Retina Geometry, Hand Geometry, Signature Verification).			
	2.3 Forensic Report: Forensic Expert, Forensic Report, Formats of Forensic Report			
	2.4 Ethics in Forensic Science.			
Unit III	**Technological Methods in Forensic Science**	8	8	
	3.1 Microscopy: Fundamental principles. Different types of microscopes. Electron microscope. Forensic applications of microscopy.			
	3.2 Chromatographic and spectroscopic evidence: Sample			

	preparation, Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography.			
	3.3 Spectroscopic methods. Fundamental principles and forensic applications of Ultravioletvisible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy and mass spectroscopy. X-ray spectrometry.			
	3.4 Electrophoresis – fundamental principles and forensic applications.			
Unit IV	**Forensic Dermatoglyphics**	7	7	
	4.1 Finger printing: Basics of Fingerprinting Introduction and history, Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae.			
	4.2 Latent prints: Constituents of sweat residue, Preservation of developed fingerprints. Digital imaging for fingerprint enhancement.			
	4.3 footprints: Importance of footprints. Casting of foot prints, Palm prnts. Lip prints - collection and examination of lip prints. Ear prints and their significance.			
	4.4 Forensic photography: Basic principles and applications of photography in forensic science. 3D photography. Photographic evidence. Videography Crime scene and laboratory photography.			
	4.5 Education and Employment systems of Forensic Science in India: Teaching Courses and Research fields in Forensic Science, Scope and jobs in Forensic Science.			

References:

1. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi.
2. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press,
3. Saferstein : Criminalistics (1976) Prentice Hall Inc., USA.
4. Deforest, Gansellen & Lee : Introduction to Criminalistics.
5. Sharma, B.R. (1974) Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 1974.
6. Hess, A.K. and Weiner, I.B. (1999) Handbook of Forensic Psychology 2nd Ed. John wiley & sons.
7. Mehta, M.K (1980) Identification of Thumb Impression & Cross Examination of Finger Prints, N.M. Tripathi Pub. Bombay.
8. Moenssens (1975) Finger Prints Techniques, Chitton Book Co. Philadelphia, NY
9. D.A. Skoog, D.M. West and F.J. Holler, Fundamentals of Analytical Chemistry, 6^{th} Edition, Saunders College Publishing, Fort Worth (1992).
10. W. Kemp, Organic Spectroscopy, 3rd Edition, Macmillan, Hampshire (1991).
11. J.W. Robinson, Undergraduate Instrumental Analysis, 5th Edition, Marcel Dekker, Inc., New York (1995).
12. D.R. Redsicker, The Practical Methodology of Forensic Photography, 2nd Edition, CRC Press, Boca Raton (2000).

Model Questions:

Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.

Short Type (At least 8):

1. Write note on Forensic Evidences
2. Write down the tools used in Crime scene investigation.
3. write note on significance of Finger printing
4. Add note on etics in forensic sciences.
5. Enlist the Branches of Forensic Science,
6. Add detailed note Concepts of Biometric Authentication.

Long Type (At least 4):

1. Explain Scope and jobs in Forensic Science
2. What is Forensic photography? Explain Basic principles and applications of photography in forensic science
3. Explain Biological basis of fingerprints
4. Describe microscopy techniques use in Forensic science.

MCQs for Internal Assessment (At least 8)

	1. Evidence to substantiate that a rape occurred could include: 1. Blood and semen 2. Hairs 3. Fibers 4. All of the above 2. Which of the following types of cells are not contained in plasma? 1. Phagocytes 2. Leukocytes 3. Erythrocytes 4. Platelets 3. The following technique is used to identify the enzymes in blood samples: (A) Southern blotting (B) Electrophoresis (C) TLC (D) Northern blotting 4. Optical components in UV spectrometer are made up of: (A) Glass (B) Quartz (C) Sodium-Halide Bromide (D) Plastic 5. 1. Deviations from Beer's Law fall into which categories? (A) Real (B) Instrumental (C) Chemical (D) All of the above 6. In GC-MS, a process in which an inert gas is bubbled through the water is known as (A) Trapping (B) Purging (C) Mixing (D) Eluting 7. Who is credited for his practical interest in fingerprints as a means of identifying workers to detect duplicate payment of wages? (A) E.R. Henry (B) William Herschel (C) Francis Galton (D) Henry Faulds 8. Which of the following method is recommended to develop latent fingerprints on human skin? (A) Ninhydrin Method (B) Amido Black Method (C) Silver-Iodine Plate Transfer Method (D) DFO Method

Sant Gadge Baba Amravati University, Amravati
FACULTY: Science and Technology

Teaching and Learning Scheme **(Bioethics and Biosafety)** for the Three Year UG Degree of Bachelor of Biotechnology(Three Years- Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): **Bioethics and Biosafety**

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentionedin the table.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106404	Bioethics and Biosafety	2	30	2 Hrs	30

Course Objectives				
Course Outcomes	CO-1: Students will be taken through what genetically modified organisms are: the existing status of biosafety programmes and safe use of living modified organisms CO-2: Define Biosafety and bioethics in the context of modern biotechnology, CO-3: Demonstrate good laboratory procedures and practices, CO-4: Describe the standard operating procedures for biotechnology research and assign Biosafety levels, CO-5: Justify the design of confinement facilities at different Biosafety levels, CO-6: Discuss the social and ethical issues related to plant and animal biotechnology			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Bioethics & Biosafety**	8	8	
	1.1 Introduction of Ethics			
	1.2 Bioethics, controversial ethical issues in biological sciences			
	1.3 Ethics involved in GMO, use of plants and animals as genetically modified models			
	1.4 Ethical issues related to environment			
Unit II	**Bioethics in Biomedical sciences**	7	7	
	2.1 Stem Cells and bioethics			
	2.2 Bioethics in clinical trials, studies involving human			
	2.3 Bioethics in IVF, Embryo research, Sex selection			
	2.4 Bioethics in Surrogacy, genetic selection and enhancement, prenatal screening and gene therapy			
Unit III	**Introduction to Biosafety**	8	8	
	3.1 biosafety issues; Biological Safety Cabinets & their types; Primary Containment for Biohazards;			
	3.2 Biosafety Levels of Specific Microorganisms. Biosafety Guidelines: Biosafety guidelines and regulations (National and International);			
	3.3 GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture;			

Unit IV	**Risk Analysis and Guidelines**	7	7	
	4.1 Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication.			
	4.2 Occupational health risks and immunoprophylaxis			
	4.3 GMP and GLP			
	4.4 Safety and ecological assessment of drugs, vaccines, feeds, foods and food products			
	References			
	1. Bioethics Across the Globe by Akira Akabayashi 2. Ethical Guidelines for Biomedical research on Human Subjects, Indian Council of Medical Research, New Delhi,20003. 3. National Ethical Guidelines for Biomedical and Health research in human participants, ICMR, 2017. 4. Biological Safety: Principles and Practices. Edited By; Dawn P. Wooley, Karen B. Byers 5. Biosafety in Microbiological and Biomedical Laboratories. Edited by L. Casey Chosewood, & Deborah E. Wilson.			
Model Questions:	Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.			
	Short Type (At least 8): 1. What are bioethics? List out ethics involved in GMO. 2. Comment on ethics involved in stem cell research. 3. What are different biosafety levels? 4. What are different regulatory authorities for biosafety? 5. What are GMP and GLP? 6. What are occupational health risks?			
	Long Type (At least 4): 1. Give an account on controversial ethical issues in biological sciences? 2. Describe in detail the ethics related to GMO and environment? 3. Explain safety and ecological assessment of drugs, vaccines,. 4. Discuss the ethics in IVF, embryo research and prenatal screening.			
	MCQs for Internal Assessment (At least 8) 1) FDA and EPA stands for; A) Foreign drug administration; Environmental protection agency B) Food and drug administration; Environmental protection agency C) Foreign drug association; European protection agency D) Food and drug administration; European protection agency 2) PPE is: A) Personal protective equipment B) Public protective equipment C) Possible protective equipment D) All of the above 3) Chose the most controversial form of genetic engineering in medicine; A) Production of cheap, easily stored vaccine for major childhood diseases B) The use of cloning technology to create organ for transplantation purpose C) Large organ transplantation from other species D) Use of GMO for environmental clean-up in various part of world 4) When working with infectious biological material, the best place to perform the work would be: A) In a Biological Safety Cabinet B) On the laboratory bench C) On a clean bench, wearing a dust mask D) In a Fume Hood 5) IVF stands for; A) Internal variance factor B) In vivo forest C) In vitro fertilization			

	D) In vitro forest 6) Chemical, reagents or broth cultures should be pipetted by _____? A) mouth B) pipetter C) ear D) nose 7) Biosafety rules says that; A) Students can have tea in laboratory B) Students should wear lab coats while working in the laboratory C) Mouth pipetting is allowed D) All of the above 8) Genetically modified crops cannot be released directly in to environment because; A) They are difficult to release B) They are difficult to digest C) They may pose a risk of unintended gene transfer D) All of the above

Sant Gadge Baba Amravati University
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Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Biotechnology
(Three Years- Six Semesters Bachelor's Degree Programme)

Course Template for Entrepreneurship approaches in Plant Tissue culture

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	106501	**Entrepreneurship approaches in Plant Tissue culture**	2	30	2 Hrs	30

The Curriculum of any Course shall be designed as per following template:

Course Objectives:				
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Understand the Entrepreneurial Opportunities in Plant Tissue Culture. CO-2: Understand the Business Development CO-3: Understand the Ethical considerations in Plant tissue culture. CO-4: Understand the entrepreneurial ventures development.			
Unit System	**Contents Lab practicals**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I Practicals	**Introduction to Plant Tissue Culture**	8	8	
	1.1: Demonstration of aseptic techniques for plant tissue culture			
	1.2: Preparation of culture media for plant cell culture			
	1.3: Subculturing of plant cells in culture vessels			
Unit II Practicals	**Business Model Development**	7	7	
	2.1: Group project to develop a business model for a fictional plant tissue culture company, Presentation of the business model to the class for feedback			
	2.2: Market Analysis, Discussion of regulatory requirements for commercializing plant tissue culture products			
	2.3: Research on market trends and opportunities in plant tissue culture Presentation of findings and recommendations for market entry			
Unit III Practicals	**Regulatory Compliance**	8	8	
	3.1 Case study analysis of regulatory issues faced by plant tissue culture companies			
	3.2:Discussion of patenting strategies for plant tissue culture products			
	3.3 Group discussion on ethical considerations in plant tissue culture			

Unit IV Practicals	**Business Plan Development**	7	7	
	4.1: Presentation of the business plan to a panel of industry experts for evaluation			
	4.2: Group project to develop a business plan for a startup plant tissue culture company			
	4.3: Debate on a controversial ethical issue related to plant tissue culture			
References:	● "Plant Tissue Culture: Techniques and Experiments" by Roberta H. Smith ● "Plant Cell Culture Protocols" edited by Victor M. Loyola-Vargas and Neftalí Ochoa-Alejo - ● "Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies" ● "Essentials of Entrepreneurship and Small Business Management" by Norman M. Scarborough ● "Plant Tissue Culture: Development and Biotechnology" by Edwin R. George and Michael A. Hall ● "Introduction to Biotechnology" by William J. Thieman and Michael A. Palladino			

Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Biotechnology
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Course Template for Entrepreneurship approaches in Animal Tissue culture

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	106502	**Entrepreneurship approaches in Animal Tissue culture**	2	30	2 Hrs	30

The Curriculum of any Course shall be designed as per following template:

Course Objectives:				
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Understand the Entrepreneurial Opportunities in Animal Tissue Culture. CO-2: Understand the Business Development CO-3: Understand the Ethical considerations in animal tissue culture. CO-4: Understand the entrepreneurial ventures development.			
Unit System	**Contents Lab practicals**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I Practicals	**Introduction to Animal Tissue Culture**	8	8	
	1.1: Hands-on experience with aseptic techniques			
	1.2: Preparation of culture media for animal cell culture			
	1.3: Subculturing of animal cells in culture dishes			
Unit II Practicals	**Business Model Development**	7	7	
	2.1: Group project to develop a business model for a fictional animal tissue culture company, Presentation of the business model to the class for feedback			
	2.2: Research on market trends and opportunities in animal tissue culture, Presentation of findings and recommendations for market entry			
	2.3: Intellectual property rights and patenting in animal tissue culture			
Unit III Practicals	**Regulatory Compliance**	8	8	
	3.1 Discussion of regulatory requirements for commercializing animal tissue culture products			
	3.2:Case study analysis of regulatory issues faced by animal tissue culture companies			
	3.3 Compliance and quality assurance in animal tissue culture			
Unit IV Practicals	**Ethical Considerations**	7	7	
	4.1: Group discussion on ethical considerations in			

	animal tissue culture, planning and management of Animal tissue culture			
	4.2: Debate on a controversial ethical issue related to animal tissue culture			
	4.3: Group project to develop a business plan for a startup animal tissue culture company			
	4.4: Presentation of the business plan to a panel of industry experts for evaluation			
References:	● Freshney, R. Ian. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. John Wiley & Sons, 2015. ● Masters, John R. Animal Cell Culture: Essential Methods. John Wiley & Sons, 2018. ● "Plant Tissue Culture: Techniques and Experiments" by Roberta H. Smith ● "Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies" by Craig Shimasaki			

Sant Gadge Baba Amravati
UniversityFACULTY: Science and
Technology
Teaching and Learning Scheme (Cell Biology) for the Three Year UG Degree of Bachelor of Biotechnology(Three Years- Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): **Microbial and Cell Staining Techniques**

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentionedin the table.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106601	**Microbial and Cell Staining Techniques**	2	30	2 Hrs	30

Course Objectives :				
Course Outcomes:	CO-1:Understand the fundamental principles of staining techniques CO-2: Demonstrate proficiency in basic microscopy and sample preparation CO-3: Explore advanced staining techniques and emerging trends CO-4: Promote lifelong learning and curiosity CO-5: Develop practical microbiology laboratory skills			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Simple Staining Techniques** Practicals: 1. Perform simple staining using crystal violet, methylene blue, and safranin. 2. Microscopic examination of stained bacterial and eukaryotic cell samples. 3. Step-by-step execution of Gram staining on bacterial smears. 4. Differentiation and microscopic observation of Gram-positive and Gram-negative bacteria. 5. Practice acid-fast staining using Ziehl-Neelsen and Kinyoun methods. 6. Identification of acid-fast organisms in stained samples.	8	8	
Unit II	**Specialized Staining Techniques** 1. Perform endospore staining on bacterial samples. 2. Observation of endospore structures under the microscope. 3. Capsule staining techniques on bacterial samples. 4. Microscopic examination of bacterial capsules. 5. Demonstration and practice of flagella staining on bacterial samples. 6. Observation of flagella arrangements. 7. Techniques for negative staining of microbial samples. 8. Microscopic observation of negatively stained	7	7	

	specimens.			
Unit III	**Fluorescent Staining** 1. Hands-on practice with fluorescent dyes and visualization under a fluorescence microscope. 2. Perform immunohistochemistry procedures using antibodies. 3. Visualization of immunostained samples under the microscope 4. H&E staining of tissue sections. 5. Microscopic examination and interpretation of stained tissues.	8	8	
Unit IV	**Advanced Techniques and Emerging Trends** 1. Hands-on experience with FISH techniques. 2. Introduction to live cell imaging techniques. 3. Observation of live cells using advanced microscopy. 4. Overview and demonstration of 3D imaging methods. 5. Practical application of 3D imaging in microbial and cell samples.	7	7	
	References			
	1. "Microbe" by Michele Swanson, Gemma Reguera, and Hazel Barton 2. "Brock Biology of Microorganisms" by Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, and W. Matthew Sattley 3. "Color Atlas and Textbook of Diagnostic Microbiology" by Elmer W. Koneman, Stephen Allen, and D. W. Alle 4. "Histology: A Text and Atlas" by Michael H. Ross, Wojciech Pawlina 5. "Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter 6. "Techniques in Microbiology: A Student Handbook" by John M. Lammert, Susan M. Russell 7. "Diagnostic Medical Parasitology" by Lynne Shore Garcia 8. "Fluorescence Microscopy: From Principles to Biological Applications" by Ulrich Kubitscheck 9. "Immunohistochemistry: Basics and Methods" by Ralf J. Rieker and Reinhard von Wasielewski 10. "Laboratory Safety for Chemistry Students" by Robert H. Hill Jr. and David C. Finster 11. "Textbook of Microbiology" by Prof. C.P. Baveja 12. "Textbook of Microbiology" by Ananthanarayan and Paniker 13. "A Textbook of Cell Biology" by P.S. Verma and V.K. Agarwal **14.** "Microbiology: A Textbook" by R. Ananthanarayan and C.K. Jayaram Paniker			

Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Biotechnology
(Three Years- Six Semesters Bachelor's Degree Programme)

Course Template for Clinical Lab Technology

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	106602	**Clinical Lab Technology**	2	30	2 Hrs	30

The Curriculum of any Course shall be designed as per following template:

Course Objectives:				
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Understanding of Laboratory Safety CO-2: To learn the Proficiency in Hematological Techniques CO-3: Understand the Competence in Clinical Chemistry. CO-4: Understand the entrepreneurial ventures in clinincal technology			
Unit System	**Contents Lab practicals**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I Practicals	**Introduction to Clinical Laboratory Techniques**	8	8	
	1.1: Introduction to laboratory safety procedures#			
	1.2: Familiarization with laboratory equipment and instruments			
	1.3: Basic principles of laboratory organization and management			
Unit II Practicals	**Hematology**	7	7	
	2.1: Blood sample collection techniques			
	2.2: Hematological tests: complete blood count (CBC), hemoglobin estimation, hematocrit determination			
	2.3: Blood smear preparation and staining techniques			
	2.4 Examination of blood cells under the microscope			
Unit III Practicals	**Clinical Chemistry**	8	8	
	3.1 Introduction to biochemical tests and their clinical significance			
	3.2:Basic principles of spectrophotometry and colorimetry			
	3.3 Performing biochemical tests: glucose estimation, liver function tests (e.g., ALT, AST, ALP), renal function tests (e.g., creatinine, blood urea nitrogen)			
	3.4 Interpretation of biochemical test results			
Unit IV Practicals	**Microbiology**	7	7	
	4.1: Aseptic techniques for microbiological culture			
	4.2: Culture and identification of common bacterial pathogens			
	4.3: Antimicrobial susceptibility testing using disk diffusion method			
	4.4: Introduction to staining techniques: Gram staining, acid-fast staining			
References :	● "Clinical Laboratory Hematology" by Shirlyn B. McKenzie, Lynne Williams, and John N.			

	McKenzie ● "Clinical Chemistry: Principles, Techniques, and Correlations" by Michael L. Bishop, Edward P. Fody, and Larry E. Schoeff ● "Clinical Microbiology Procedures Handbook" by Amy L. Leber ● "Clinical Immunology and Serology: A Laboratory Perspective" by Christine Dorresteyn Stevens and Linda E. Miller ● "Clinical Laboratory Management" by Lynne S. Garcia ● "Clinical Laboratory Science Review" by Robert R. Harr

Semester I BSc Biotechnology					
S. No	**The Vertical**	**Type of course**	**Course code**	**Course name**	**Name of the Faculty**
1.	Major	Theory + Lab practical	106201	Cell Biology	Ankit Sir
2.	Major	Theory + Lab practical	106202	Plant Physiology	Gokul Sir
3.	Generic/Open Elective	Theory	106401	Microbial Technology	Done
4.	Generic/Open Elective	Theory	106402	Developmental Biology	Aswin Sir
5.	VSC	Lab/Practical	106501	Entrepreneurship approaches in Plant Tissue Culture	Ankit SIr
6.	SEC	Lab/Practical	106601	Microbial and cell staining	Done
Semester II BSc Biotechnology					
S. No	**The Vertical**	**Type of course**	**Course code**	**Course name**	**Name of the Faculty**
1.	Major	Theory + Lab practical	106203	Mammalian Physiology	Aswin SIr
2.	Major	Theory + Lab practical	106204	Bioenergetics, Biomolecules and Metabolism	Aswin Sir
3.	Minor	Theory	106301	Introduction of Areas in Biotechnology	Done
4.	Generic/Open Elective	Theory	106403	Elementary forensic science	Done

5.	Generic/Open Elective	Theory	106404	Bioethics and Biosafety	Shinde Sir
6.	VSC	Lab/Practical	106502	Entrepreneurship approaches in Animal Tissue culture	Himanshu SIr
7.	SEC	Lab/Practical	106602	Clinical Lab Technology	Gokul Sir

Sant Gadge Baba Amravati
UniversityFACULTY: Science and
Technology
Teaching and Learning Scheme (Cell Biology) for the Three Year UG Degree of Bachelor of Biotechnology(Three Years- Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): Cell Biology

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentioned in the table.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106201	Cell Biology	2	30	2 Hrs	30

Course Objectives:				
Course Outcomes:	CO-1: Understand the basic and advanced concepts in Microscopy CO-2: Understand the Cell as a basic structural and functional unit of lifeCO-3: Differentiate prokaryotic and eukaryotic Cell. CO-4: Understand the structure and functions of various cell organelles CO-5: Understand the basics of Cell organization			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Cell: functional unit of life**	8	8	
	1.1: Cell: Definition, concept, history of cytology with reference to the cell and cell division			
	1.2: Cell size and shape, its elemental and organic composition, unicellular and multicellular organisms			
	1.3: Types of cells: Prokaryotic and Eukaryotic cells, compartmentalization of eukaryotic cells			
	1.4: Introduction to the cell organelles			
Unit II	**Cell: functional unit of life**	7	7	
	2.1: Structure and functions of: • Nucleus • Endoplasmic Reticulum (Smooth and Rough)			
	2.2: Structure and functions of: • Golgi complex • Ribosomes (prokaryotic and Eukaryotic)			
	2.3: Structure and functions of: • Mitocondria • Plastids (types)- chloroplast (structure and functions)			
	2.4: Structure and functions of: • Lysosomes: Vacuoles and micro bodies • Cell wall			
Unit III	**Cell membrane and cell motility**	8	8	
	3.1: Cell membrane and permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, cell recognition and membrane transport.			
	3.2: Membrane Vascular system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments.			
	3.3: Structure and functions of cilia and flagella			
	3.4: Movement of cilia and flagella			
Unit IV	**Cell Division**	7	7	

	4.1: Cell cycle: G-phase, S-phase and M-phase 4.2: Mitosis: concept and phases of mitosis 4.3: Meiosis: concept, types and phases 4.4: Significance of mitosis & Meiosis and Differences			

References:	1) Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6thEdition. John Wiley & Sons. Inc. 2) De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular 3) Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia. 4) Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular 5) Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 6) Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The Worldof the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco. 7) Albert M. Lewis, Introduction to cell biology and microbiology 8) Powar, C. B. and Daginawala, H. F. (2010). General Microbiology Vol. I and II, 2nd edition, Himalaya Publishing House, Mumbai 9) Powar, C.B. (2012). Cell Biology, 3rdedition, Himalaya Publishing House, Mumbai

Syllabus prescribed for academic session 2024-2025 and onward

Lab-1 Practical (B.Sc.
Semester I) Programme: B.Sc.
Biotechnology

CO: Upon completion of this course successfully, students would be able to

1. Adapt basic knowledge on various techniques and areas of cell biology.
2. To design and execute experimental procedures in cell biology.

Lab-1 Practical (B.Sc. Semester I) based on course code 106200 and 106201

1. To preapare permanent slide by using plant material like leaf, stem or root.
2. Study the effect of temperature and organic solvents on semi permeable membrane.
3. Demonstration of dialysis.
4. Study of plasmolysis and de-plasmolysis.
5. Demonstrate Cell fractionation and identification of cell fraction
6. Study of structure of any Prokaryotic cell.
7. Study of structure of any Eukaryotic cell.
8. Study of Cell division (Meiosis) in onion flower bud.
9. Study of Cell division (Mitosis) in onion root tip.
10. Study of osmosis (Exo and Endo).
11. Demonstration of Centrifugation.
12. Trypan blue exclusion of assay for cell viability.

	Short Questions: 1) What is the basic structural unit of all living organisms? 2) Define the term "cell theory." 3) Name the two main types of cells and briefly describe their differences. 4) What is the function of the cell membrane? 5) Define the term "organelle." 6) Name the three components of the cytoskeleton. 7) What is the primary function of the mitochondria? 8) Briefly explain the difference between prokaryotic and eukaryotic cells. 9) What is the role of the endoplasmic reticulum in the cell? 10) Name the organelle responsible for protein synthesis. 11) Define the term "cellular respiration." 12) What is the function of the Golgi apparatus? 13) Explain the difference between diffusion and osmosis. 14) What is the purpose of the cell cycle? 15) Name the stages of mitosis in order. 16) Define apoptosis. 17) What is the role of ribosomes in the cell?
	Long Questions: 1) Explain the cell theory and its significance in biology. 2) Compare and contrast plant and animal cells in terms of structure and organelles. 3) Describe the fluid mosaic model of the cell membrane. 4) Discuss the structure and function of the nucleus in eukaryotic cells. 5) Describe the process of cellular respiration, highlighting its different stages. 6) Explain the stages of the cell cycle and the events that occur in each stage. 7) Discuss the process of mitosis and its significance in cell division. 8) Describe the structure and function of the mitochondria in detail. 9) Explain the roles of smooth and rough endoplasmic reticulum in the cell. 10) Discuss the structure and function of the Golgi apparatus. 11) Explain the principles of diffusion and osmosis, providing examples. 12) Describe the process of transcription and translation in gene expression. 13) Discuss the structure of DNA and its role in heredity. 14) Explain the significance of enzymes in cellular processes. 15) Describe the stages of meiosis and compare them with mitosis. 16) Explain the concept of homeostasis in the context of cell biology.
	Multiple-choice questions (MCQs) related to cell biology: 1) What is the primary function of the cell membrane? a. Energy production b. Structural support c. Cellular communication d. Selective barrier

2) Which organelle is responsible for synthesizing ATP in eukaryotic cells?

a. Endoplasmic reticulum
b. Golgi apparatus
c. Mitochondria
d. Nucleus

3) What is the main function of ribosomes in the cell?

a.Protein synthesis
b. Lipid synthesis
c. ATP production
d. DNA replication

4) In which phase of the cell cycle does DNA replication occur?

a. G1 phase
b. S phase
c. G2 phase
d. M phase

5) Which cellular process is responsible for breaking down and recycling cellular components? a. Mitosis
b. Apoptosis
c. Autophagy
d. Cytokinesis

6) What is the primary function of the Golgi apparatus?

a. Protein synthesis
b. Lipid synthesis
c. Sorting and modifying cellular products
d. ATP production

7) Which statement about prokaryotic cells is true?

a. They have a nucleus.
b. They lack a cell membrane.
c. They have membrane-bound organelles.
d. They lack a true nucleus and membrane-bound organelles.

8) Which cellular structure is composed of microtubules and microfilaments and provides structural support to the cell?

a. Cytoskeleton
b. Endoplasmic reticulum
c. Nucleus
d. Golgi apparatus

9) What is the correct order of stages in mitosis? a. Prophase, Metaphase, Anaphase, Telophase
b. Anaphase, Metaphase, Prophase, Telophase
c. Metaphase, Prophase, Anaphase, Telophase
d. Telophase, Anaphase, Metaphase, Prophase

10) Which cellular organelle is involved in detoxification processes and lipid metabolism?
a. Peroxisome
b. Lysosome
c. Endoplasmic reticulum
d. Golgi apparatus

Answers:

d. Selective barrier

c. Mitochondria

a. Protein synthesis

b. S phase

c. Autophagy

	c. Sorting and modifying cellular products d. They lack a true nucleus and membrane-bound organelles. a. Cytoskeleton a. Prophase, Metaphase, Anaphase, Telophase a. Peroxisome

Sant Gadge Baba Amravati
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Technology
Teaching and Learning Scheme (Cell Biology) for the Three Year UG Degree of Bachelor of Biotechnology(Three Years- Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): Plant Physiology

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentioned in the table.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	10620	Plant Physiology	2	30	2 Hrs	30

Course Objectives:				
Course Outcomes:	CO-1: Understanding of Plant Physiology Concepts CO-2: Knowledge of Plant Growth and Development CO-3: Ability to Analyze Plant Responses to Environmental Stimuli CO-4: Competence in Laboratory Techniques CO-5: Awareness of Current Issues in Plant Physiology			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Plant Physiology**	8	8	
	1.1: Definition and scope of plant physiology			
	1.2: Historical developments in the field of plant physiology			
	1.3: Importance of plant physiology in agriculture and biotechnology			
	1.4 Recent advances in understanding plant physiology			
Unit II	**Plant Tissues and Plant Water Relations**	7	7	
	2.1: Structure and function of plant cells Plant tissue types and their roles in plant physiology Cell division and growth in plants			
	2.2: Water uptake and transport in plants			
	2.3 Transpiration and its role in plant water balance Plant adaptations to water stress			
	2.4 Research methods and techniques in plant physiology			
Unit III	**Mineral Nutrition**	8	8	
	3.1:Essential elements for plant growth			
	3.2: Mechanisms of nutrient uptake and transport			
	3.3: Nutrient deficiencies and their effects on plant physiology			
	3.4: Implications of plant physiology research for agriculture and environmental conservation			
Unit IV	**Plant Development and Plant growth regulators**	7	7	
	4.1: Seed germination and seedling growth Flowering and fruit development Senescence and programmed cell death in plants			

	4.2: Types and functions of plant hormones Hormone signaling pathways in plants			
	4.3: Role of hormones in plant growth, development, and responses to environmental stimuli			

References:	● "Plant Physiology" by Lincoln Taiz and Eduardo Zeiger ● "Plant Physiology and Development" by Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn ● "Plant Physiology" by Frank B. Salisbury and Cleon W. Ross ● "Physiology of Crop Production" by K.P. Singh - This book focuses on the physiological processes that govern crop growth and development, with an emphasis on practical applications in agriculture. ● "Plant Physiology: A Treatise, Volume IB: Physiology of Development: From Seeds to Sexuality" by Torrey John G ● "Physiology and Biochemistry of Drought Tolerance in Plants" by U. Chaturvedi and M.N.V. Prasad ● "Plant Physiology: Molecular, Biochemical, and Physiological Fundamentals of Metabolism and Development" by Hans-Henning Kunz ● "Plant Physiology: With Reference to the Green Plant" by R.O. Whyte

Syllabus prescribed for academic session 2024-2025 and onward

Lab-1 Practical (B.Sc. Semester I) Programme: B.Sc. Biotechnology

1. Photosynthesis Rate Measurement
2. Stomatal Density and Distribution
3. Water Potential Measurement
4. Chlorophyll Extraction and Quantification
5. Respiration Rate Measurement: Determine the respiration rate of germinating seeds or plant tissues using a respirometer.
6. Seed Germination and Growth Analysis
7. Mineral Nutrient Deficiency Symptoms
8. Hormone Effects on Plant Growth.
9. Phototropism Experiment:
10. Water Stress Response
11. Leaf Absorption Spectrum
12. Plant Growth under Different Light Conditions

Short Questions:

1) Define transpiration.
2) Explain the role of auxins in plant growth.
3) What is the difference between C3 and C4 plants?
4) Define photoperiodism.
5) Describe the process of mineral nutrient uptake in plants.
6) What is the role of gibberellins in seed germination?
7) Explain the process of water potential in plants.
8) What is the significance of stomata in plant physiology?
9) Define apical dominance.
10) Explain the concept of osmotic potential.

Long Questions:

1) Discuss the process of photosynthesis in plants, highlighting the role of light and dark reactions.
2) Describe the mechanisms of plant water uptake and transport in the xylem.
3) Explain the role of plant hormones in plant growth and development, using specific examples.
4) Discuss the adaptations of plants to different environmental stresses, such as drought or salinity.
5) Describe the process of seed germination, including the role of hormones and environmental factors.
6) Explain the process of transpiration in plants and its significance in water transport.
7) Discuss the role of phytochromes in plant responses to light and photoperiodism.
8) Describe the process of mineral nutrient uptake in plants, including the types of nutrients and their functions.
9) Explain the process of respiration in plants, including glycolysis, the citric acid cycle, and oxidative phosphorylation.
10) Discuss the importance of plant physiology in agriculture and biotechnology, with examples.

Multiple-choice questions (MCQs) related to cell biology:

11) 1. Which of the following is a primary pigment involved in photosynthesis?

A. Chlorophyll a B. Xanthophyll C. Carotenoid D. Phycobilin Answer: A

12) The opening and closing of stomata are regulated by:

A. Auxins B. Cytokinins C. Abscisic acid D. Ethylene Answer: C

13) Which of the following is a macronutrient required for plant growth?

A. Iron B. Zinc C. Nitrogen D. Manganese Answer: C

14) The enzyme responsible for carbon fixation in the Calvin cycle is:

A. Rubisco B. ATP synthase C. NADP reductase D. Phosphofructokinase Answer: A

15) Photoperiodism is a response of plants to:

A. Light intensity B. Temperature C. Day length D. Soil pH Answer: C

16) Which plant hormone is responsible for cell elongation?

A. Gibberellin B. Auxin C. Cytokinin D. Ethylene Answer: B

17) The process by which plants bend toward light is called:

A. Phototropism B. Gravitropism C. Thigmotropism D. Chemotropism Answer: A

18) The process of breaking dormancy in seeds is known as:

	A. Germination B. Imbibition C. Stratification D. Vernalization Answer: A 19) The movement of sugars from sources to sinks in plants occurs through: A. Xylem B. Phloem C. Parenchyma cells D. Collenchyma cells Answer: B 20) The process of water loss from plant leaves through stomata is called: A. Evaporation B. Transpiration C. Absorption D. Osmosis Answer: B

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Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Biotechnology
(Three Years- Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): Mammalian Physiology

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

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Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	106203	Mammalian Physiology	2	30	2Hrs	30

CourseObjectives:	CO 1 This course will review general principles of the function of the human body as a mammal, with emphasis on the function and regulation of neuromuscular, cardiovascular, respiratory, endocrine, digestive, and excretory systems. CO 2 The goal is to provide students with the basic knowledge to understand how their own bodies operate.			
Course Outcomes:	CO1: Understand the physiology of respiration CO2: Attain knowledge about physiology and mechanism of digestion & absorption CO3: Understand the Circulation of body fluid (Blood and Lymph), Role of Hearth and blood vessels in blood circulation CO4: Acquire knowledge about mechanism of blood Coagulation CO5: Understand physiology of muscle and role of muscle contraction in movement and locomotion. CO6: Understand the concept of excretion and Osmoregulation CO7: Able to understand the Physiology Nervous and Endocrine coordination in Human Body.			
UnitSystem	Contents	Workload Allotted (Hrs)	Weightage of MarksAllotted	IncorporationofPedagogies
UnitI	**Digestion and Respiration**	8	8	
	1.1: Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids.			
	1.2: Composition of bile, Saliva, Pancreatic, gastric and intestinal juice			
	1.3: Respiration: Exchange of gases, Transport of O2 and CO2.			
	1.4: Oxygen dissociation curve, Chloride shift.			
UnitII	**Circulation**	7	7	
	2.1: Blood : Definition and its constituents, functions of blood. Heart: Structure of human heart, pace maker, Cardiac cycle.			
	2.2 Blood coagulation factors, blood groups A, B, O system and Rh-factor.			
	2.3: Haemopoisis, Mechanism of coagulation of blood.			
	2.4: Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.			
UnitIII	**Muscle physiology and osmoregulation**	8	8	
	3.1: Structure of cardiac, smooth & skeletal muscle,			

	threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.			
	3.2: Mechanism of muscle contraction by Sliding filament theory summation of Stimuli, all or none law, fatigue, rigor mortis.			
	3.3 Types of Muscles: striated, non-striated and cardiac muscles E.M. Structure and Chemical Composition of striated muscle, Neuromuscular junction.			
	3.4 Excretion: modes of excretion, mammalian Excretory system, Ornithine cycle, Mechanism of urine formation.			
UnitIV	Nervous and endocrine coordination	7	7	
	4.1: Neuron: E.M. Structure of nuron andTypes : Myelinated and non-Myelinated nerve fibres			
	4.2: . Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters.			
	4.3 Endocrine system: Hormones and their physiological roles of- Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions			
	4.4 Hormonal disorders: Dwarfism, Gigantism, Acromegaly , Goiter, Myxoedema, Cretinism, Osteoporosis , .			

References:	1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. 2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc. 3. Prosser and Brown : Comparative Animal Physiology 4. Hisotlogical Slides of Respirator systems, circulatory system, Muscles, Nervous system Endocrine glands, Gonads, placentae 5. Best and Taylor : Physiological basis of Medical practice 6. C Hoar, W.S.. General and comparative Physiology. Prentice Hall of India. 7. Nagabushnam, R.. Animal physiology. S.Chand & co. 8. Martin, D.W. P.A. Mayes and W.W. Rodwell,.Harper's Review of Biochemistry lange Medical Publications. 9. Prosser, C.L. and F.A.Brown Comparative Animal physiology. W.B. Suanders. 10. Rama Rao, A.V.S.S.. Biochemistry. UBSPD. 11. Stryer. L. Biochemistry Wiley International 12. Verma, P.S. and V.K. Agarwal.. Animal physiology. S.Chand & co. 13. Wilson, J.A., Principles of Animal Physiology, Macmillan 14. Chatterjee, C.J; Human Physiology(Vol-I and II 15. Lehninger. L.. Biochemistry. W.H. Freeman & co.

Practicals

1. Determination of blood groups in human being.
2. Differential counts of blood.
3. Determination of hemoglobin percentage with the help of haemometer.
4. Finding the coagulation time of blood
5. R.B.C. count.
6. W.B.C. count.
7. Preparation of haemin crystals
8. Measurement of blood pressure.
9. Action of salivary amylase on starch.
10. Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample.
11. Demonstration of kymograph unit, Respirometer through available resources.
12. Study of any five clinical conditions associated with hypo/hyper active endocrine glands using photographs (Gigantism, dwarfism, acromegaly, cretinism, myxodema, Graves' disease, cushion's disease)

Sant Gadge Baba Amravati University
FACULTY: Science and Technology

Teaching and Learning Scheme (Bioenergetics, Biomolecules and Metabolism) for the Three Year UG Degree of Bachelor of Biotechnology

(Three Years-Six Semesters Bachelor's Degree Programme)

Course (Theory Curriculum): Bioenergetics, Biomolecules and Metabolism

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentioned in the table.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	II	106204	Bioenergetics, Biomolecules and Metabolism	2	30	2Hrs	30

Course Objectives :	CO-1: To provide comprehensive Understanding of Biogenetics, Biomolecules and Metabolism. CO-2: To acquaint students with bioenergetics, biomolecules and metabolism. CO-3. To make students understand the importance of biomolecules in life.			
Course Outcomes:	CO-1:Underst and the biogenetics process in the cell. CO-2:Understand the enzymes, mechanism and their functions. CO-3: Understand the carbohydrate metabolism. CO-4:Understand the lipid metabolism. CO-5:Understand the lipid metabolism disorders.			
Unit System	Contents	Workload Allotted (Hrs)	Weightage ofMarks Allotted	Incorporationof Pedagogies
UnitI	Bioenergetics and vitamins	8	8	
	1.1: Energy and its form,Free energy, pH			
	1.2:Laws of thermodynamics, enthalpy and entropy			
	1.3:Redox potential, ATP bioenergetics			
	1.4: Vitamins: Dietary sources, Deficiency manifestation, biological functions of fat soluble and water-soluble vitamins.			
UnitII	Enzymes:	7	7	
	2.1:Definition, Classification and Nomenclature			
	2.2:Terminology:Substrate,prosthetic group, coenzyme, cofactor, activesite, inductive enzymes, allosteric enzymes, Isozymes, metalloenzymes, ribozymes			
	2.3:Effect of temperature, pH, substrate Concentration and enzyme concentration on enzyme catalyzed reactions			
	2.4:Mechanism of enzyme action (Lock and Key Model; Induced fit model)			
UnitIII	Carbohydrate metabolism:	8	8	
	3.1:Glycolysis and energy account			
	3.2:Glycogenolysis and its importance			
	3.3:Glycogenesis and its importance			
	3.4:Pentosephosphate pathway			
UnitIV	Lipid metabolism:	7	7	
	4.1:Fatty acid biosynthesis			
	4.2:Beta-oxidation of fatty acids			

	4.3:Cholesterol synthesis 4.4:Lipid metabolism disorders (Gaucher disease; Tay-Sacs disease)			
References:	1. Lehninger Principles of Biochemistry By:David L.NelsonandCox 2. Biochemistry By:Rex Montgomery 3. Harper's Biochemistry By: RobertK.Myrray 4. Enzymes By:Trevor Palmer 5. Enzyme structure and mechanism By:Alan Fersht 6. Principles of Biochemistry By:Donald J. Voet, JudithG. Voet, Charlotte 7. Satyanarayana, U. and Chakrapani U. (2010) Biochemistry, Books and Allied Pvt. Ltd., Kolkata, India. 8. Agarwal, G. R. Agarwal K., Agarwal O. P. (2005) Text Book of Biochemistry, 13th edn., Goel Publishing House, Krishna Prakashan Media Pvt. Ltd., Meerut, India. 9. Jain, J.L., Jain,S. and Jain,N. (2005) Fundamentals of Biochemistry, 6th edn., S. Chand and Company Ltd., Delhi. 10. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006) Biochemistry, VI Edition, W.H Freeman and Co			

Practicals.

1.Qualitative tests for carbohydrates .

2. Qualitative tests for lipids.

3. Qualitative test for amylase .

4. To study the effect of pH on the activity of salivary amylase enzyme.

5. To study the effect of temperature on the activity of salivary amylase enzyme.

6. Extraction and detection of Starch from Potatoes/ maize.

7. Estimation of carbohydrates by DNSA method .

8. Separation of carbohydrates by paper chromatography.

9. Estimation of reducing sugars by DNSA method.

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Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Biotechnology
(Three Years- Six Semesters Bachelor's Degree Programme)

Course Template for Theory Curriculum: Introduction of Areas in Biotechnology

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106301	**Introduction of Areas in Biotechnology**	2	30	2 Hrs	30

The Curriculum of any Course shall be designed as per following template:

Course Objectives:				
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Understand the Application of Biotechnology in Agriculture and Food industries. CO-2: Understand the Application of Biotechnology in Fermentation technology and in Pharma. CO-3: Understand the gene editing and cloning. CO-4: Understand the new product development methods by genetic engineering CO-5: Understand the cell culture methods. CO-6:Understand the importance of IPR and Patent importance.			
Unit System	**Contents**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I	**Biotechnology in Agriculture, Nanosciences, and Food industries**	8	8	
	1.1: Medical Biotechnology: Gene therapy, Diagnostic techniques			
	1.2: Agricultural Biotechnology: Genetically modified organisms (GMOs), Crop improvement and genetic engineering in agriculture			
	1.3: Nanobiotechnology: Introduction to Nanotechnology in Biotechnology & their Applications in medicine and industry			
	1.4: Food Biotechnology: Food preservation, Genetically modified foods, Bt- Cotton			
Unit II	**Fermentation technology and Environmental Biotechnology in industries**	7	7	
	2.1: Environmental Biotechnology: Bioremediation, Waste treatment using biotechnological approaches			
	2.2: Industrial Biotechnology : Enzyme technology, Fermentation processes			
	2.3: Bioprocess Engineering: Upstream and downstream processing Bioreactor design and optimization			
	2.4: Pharmaceutical Biotechnology: Drug discovery and development, Biopharmaceutical production			
Unit III	**Genetic Engineering in Industries**	8	8	
	3.1 CRISPR-Cas9 Technology: Principles of CRISPR-Cas9 genome editing			
	3.2: Synthetic Biology: Design and construction of biological systems, Applications in bioproduction			
	3.3 Introdution of Genetic engineering, Cloning of gene, Chimeric DNA			
	3.4 Outcomes of Genetic engineering including Bt-Cotton, Humulin			

Unit IV	**Cell Culture & IPR in industries**	7	7	
	4.1: Basic Concepts in Plant Tissue culture: Definition and history of plant tissue culture, Importance and applications in agriculture and horticulture, Plant Cells and Tissues & Media Composition			
	4.2: Plant Callus Culture: Induction and maintenance of callus cultures, Role of plant growth regulators Suspension Culture: Methods for establishing and maintaining suspension cultures			
	4.3: Animal cell Culture methods, Transgenic development			
	4.4: Intellectual property right: Patents, R & D partnership, license agreement and joint venture			
References :	1. "Bioprocess Engineering: Principles" by Shuler and Kargi 2. "Biotechnology: Expanding Horizons" by B. D. Singh 3. "Biotechnology: Fundamentals and Applications" by Y. H. Hui and Nirmal Sinha 4. "Biotechnology: Indian Perspective" by Alok Dhawan and Satish C. Nautiyal 5. "Industrial Biotechnology: Sustainable Growth and Economic Success" by Nima Rezaei			
Model Questions:	Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.			
	Short Type (At least 8): 1. Discuss the applications of biotechnology in sustainable agriculture. 2. Discuss the potential applications of nanobiotechnology in environmental remediation. 3. How does environmental biotechnology contribute to waste treatment and management? 4. Explore the ethical considerations surrounding gene therapy. 5. Explore the role of synthetic biology in designing microbial cell factories for industrial applications. 6. Explain the challenges of patenting biotechnological innovations. 7. Explore the role of IPR in promoting innovation and investment in the biotechnology industry. 8. How are nanosciences applied in drug delivery systems in biotechnology?			
	Long Type (At least 4): 1. Discuss the role of fermentation in the pharmaceutical industry for the production of therapeutic proteins. 2. What are the ethical considerations surrounding genetically modified organisms (GMOs) in agriculture? 3.Discuss the role of fermentation in the pharmaceutical industry for the production of therapeutic proteins. 4. How has genetic engineering contributed to personalized medicine?			
	MCQs for Internal Assessment (At least 8) 1.What is the primary goal of agricultural biotechnology? A) Food preservation B) Crop improvement C) Soil conservation D) Water purification 2.Which biotechnological technique is commonly used for developing genetically modified crops? A) DNA sequencing B) PCR (Polymerase Chain Reaction) C) CRISPR-Cas9 D) Gel electrophoresis 3. Which microorganism is commonly used in alcoholic fermentation? A) Escherichia coli B) Saccharomyces cerevisiae C) Streptococcus pyogenes D) Lactobacillus acidophilus 4. What is the primary purpose of large-scale fermentation in biotechnology? A) Antibiotic production B) Enzyme synthesis C) Biofuel production D) Vaccine development 5. What is the main goal of genetic engineering in medicine? A) Crop improvement B) Drug development C) Environmental protection			

	D) Textile manufacturing 6. Which technique is commonly used in gene therapy? A) PCR B) Gel electrophoresis C) CRISPR-Cas9 D) Southern blotting 7. Why is intellectual property important in the biotechnology industry? A) To limit scientific progress B) To encourage innovation and investment C) To hinder competition D) To promote secrecy 8. Which type of intellectual property protection is commonly used for biotechnological inventions? A) Copyright B) Trademark C) Patent D) Trade secret

Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Botany
(Three Years- Six Semesters Bachelor's Degree Programme)

Syllabus for : GOEC : MICROBIAL BIOTECHNOLOGY (106401)

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106401	MICROBIAL BIOTECHNOLOGY	2	30	2 Hrs	30

Course Objectives:	1. To Learn about significance of Microbes in human health. 2. To learn about Microbial techniques and their applications.			
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Students will be able to **Recognize** importance of diversity of microbes. CO-2: Students will be able to **classify** Components and units of a bioprocess industry. CO-3: Students will **apply** knowledge to produce microbial products. CO-4: students will be able to **plan** strategies of producing Industrially important microbial enzymes and related products. CO-5: Students will be able to **develop** their own Microbial technology lab. CO-6: Students will Impart knowledge on the various industrial bioproducts CO-7: Students will get Familiarize with various sectors of industrial biotechnology			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to microbial Technology**	8	8	•
	1.1 Structure and life cycle of representative groups of Bacteria, Fungi, Algae, viruses and eukaryotic organisms; physiology of microorganisms:			
	1.2 Scope of Microbial biotechnology. Microorganisms as factories for the production of novel compounds			
	1.3 Biotechnological potentials of microalgae – food, feed Colourant, fuel and pharmaceutically valuable compounds.			
	1.4 Production of microbial biofertilizers cyanobacteria, Rhizobium, Azotobacter, Phosphobacteria and VAM.			
Unit II	**Industrial Byproducts**	7	7	
	2.1 Isolation, Preservation and Maintenance of Industrial Microorganisms.			
	2.2 Fermenter parts and components; Media for industrial fermentation; Sterilization.			
	2.3 Industrial Bioproducts– microbial synthesis of organic acids (Citric acid), alcohol (ethanol), vitamin(B12) and beverage (wine) ,			
	2.4 Industrially important microbial enzymes: Types, mode of action and industrial applications of microbial amylases and proteases			
Unit III	**Microbes in human health**	8	8	
	3.1 Microbial production of therapeutically important products:. o Antibiotics: Penicillin, Streptomycin			
	3.2 Probiotics and prebiotics: Fundamental aspects and health benefits			
	3.3 Production of single cell protein from bacteria, algae and fungi : nutritional value, substrates used, process examples, applications.			
	3.4 Cultivation of edible and medicinal mushrooms:			

	Nutritional and medicinal properties			
Unit IV	**Microbial technology and its application**	7	7	
	4.1 Microbial technology of fermented dairy products : Cheese making, Yoghurt making, Beer brewing			
	4.2 microbes in agrobiotechnology and microbial pesticides;			
	4.3 Microbes in medical biotechnology, microbes in alternative energy			
	4.4 Patenting microbial biotechnology			
	4.5 Opportunity and Career in microbial technology			

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Model Questions:	Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.
	Short Type (At least 8): 1. Explain Structure of Bacteria. 2. Explain Structure of Virus. 3. Write note on Scope of Microbial biotechnology 4. Define role of sterilization in microbial growth 5. Enlist the parts of fermenter. 6. Add detailed note on antibiotics production (penicillin), 7. Add detailed note on vitamin(B12) 8. What is Probiotics? 9. Add note Nutritional and medicinal properties of mushroom
	Long Type (At least 4): 1. Explain process of production of microbial biofertilizers 2. Write on Fundamental aspects probiotics and its health benefits 3. Explain Production of single cell protein from bacteria 4. Describe Microbial production of therapeutically important products
	MCQs for Internal Assessment (At least 8) 1. Which of the following food products come from microbes in biotechnology? A. Soy sauce B. Cheese C. Alcoholic beverages D. All are correct 2. 1. Which of these bacterial components is least likely to contain useful antigens? A. Cell wall B. Flagella C. Ribosomes D. Capsule 3. Which of the following contains structures composed of N-acetylmuramic acid and N-acetylglucosamine? A. Mycoplasmas B. Amoeba C. E.coli D. Spheroplast 4. GMO stands for _____.

	A. genetically manipulated organism B. genetically modified organism C. greatly modified organism D. genetically manufactured organism 5. The structure of RNA differs from that of DNA, as RNA contains: a) The sugar ribose instead of deoxyribose b) uracil instead of thymine c) it contain Cytosine d) a and b 6. Bacterial ribosomes typically consist of two subunits, the larger (50 S) subunit consist of: a) single RNA molecule (16 S) and 21polypeptides. b) Two RNA molecules (30 S and 50 S) plus 31 different polypeptides. c) single RNA molecule (18 S) and 21polypeptides d) Two RNA molecules (23 S and 5 S) plus 31 different polypeptides 7. The E. coli chromosome is a closed-circular DNA of length 4.6 million base pairs, which resides in a region of the cell called the: a) nucleosome b) nucleotide c) nucleoid d) DNA domains 8. Which of the following is not fermented product. a) Antibiotic b) Citric acid c) Alcohol d) Vaccine

Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Course Titles) for the Three Year UG Degree of Bachelor of Botany
(Three Years- Six Semesters Bachelor's Degree Programme)

Syllabus for : VSC : BIOINFORMATICS : TOOLS AND APPLICATIONS (106501)

Each theory paper of Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106501	**BIOINFORMATICS : TOOLS AND APPLICATIONS**	2	30	2 Hrs	30

Course Objectives:	3. To learn about significance of Tools of Bioinformatics. 4. To learn about applications of Bioinformatics.			
Course Outcomes:	As per Blooms Taxonomy (4 to 6) CO-1: Students will be able to **Recognize** importance and applications of Bioinformatics CO-2: Students will be able to **Understand** different tolls of bioinformatics. CO-3: Students will **apply** knowledge to find out single nucleotide polymorphism CO-4: Students will be able to **categorize** types of database CO-5: students will be able to **plan** strategies of Sequence visualization and Structure Visualization. CO-6: Students will be able to **develop** phylogenetic trees.			
Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Bioinformatics**	8	8	•
	1.1 Basics of computer structure, input and out devices, memory devices, Internet – IP address, TCP/IP, DNS, URL, and email			
	1.2 Bioinformatics definition, what is Bioinformatics and its relation with molecular biology?			
	1.3 History, Aims, Scope and applications			
	1.4 Career in Bioinformatics and related field			
Unit II	**Biological databases**	7	7	
	2.1 DNA Databases – GenBank, EMBL, DDBJ, understanding structure of DNA databases			
	2.2 Protein Databases – UniprotKB, Swiss Prot, TrEMBL understanding structure these databases			
	2.3 Structure Databases – PBD and Understanding its structure			
	2.4 Literature Databases – PubMed			
	Activities (Lab Work) 1. Biological Databases with Reference to Expasy and NCBI 2. Exploration of the resources available in NCBI and PUBMED 3. Retrieval of a Genbank Entry using an accession number			
Unit III	**Sequence Alignments and Visualization**	8	8	
	3.1 Introduction to Sequences, alignments and Dynamic Programming;			
	3.2 Local alignment and Global alignment (algorithm and example)			
	3.3 Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).			
	3.4 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.			
	Activities (Lab Work)			

	1. Pair-wise and multiple sequence alignment using ClustalW 2. Pair-wise and multiple sequence alignment using BLAST 3. Primary structure analysis of a protein 4.Secondary structure analysis of a protein 5.Tertiary protein structure analysis using RASMOL 6. Retrieval and analysis of a gene sequence "AF375082" in FASTA format			
Unit IV	Sequence visualization & Computational Genomics	7	7	
	4.1 Sequence visualization and Structure Visualization tools: General Overview of Map viewer, ORF Finder , Locus link.			
	4.2 Swiss PDB Viewer , Webmol , Rasmol ,Chime, MOLMOL ,Cn3D, MolScript, Phymol.			
	4.3 Computational Genomics, Computational Proteomics, Drug discovery.			
	4.4 Molecular Phylogenetics and Molecular Evolution:- Terminology, Bio-datamining , Pharmaco genomics & Chemiinformatics.			
	Activities (Lab Work) 1. Protein motif and domain analysis: a. MEME/MAST b. eMotif 2. Phylogenetic analysis – MEGA, PAUP, PHYLIP 3.Conversion of Gene Sequence into its Corresponding Amino Acid Sequence			
References:	1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004 2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009 3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999 4. Dan E Krane and Michael L Raymer, fundamental concepts of bioinformatics ,pearson Education(low priced Edition) 5. Claverie & Notredame, Bioinfomatics- A Beginners Guide, Wiley-Dreamtech India Pvt LTD, 2003			
Model Questions:	Short Type (At least 8), Long Type (At least 4) and MCQs for Internal Assessment (At least 8) wherever applicable as the need of curriculum.			
	Short Type (At least 8): 1. Write note on tools of bioinformatics. 2. Write down the aim and scope of Bioinformatics 3. write note on EMBL 4. Define uses of DDBJ 5. Enlist the Applications of genomics. 6. Add detailed note on MOLMOL 7. Explain Concept of Chemiinformatics 8. Add note on ORF Finder			
	Long Type (At least 4): 1. Explain Pair-wise and multiple sequence alignment using ClustalW 2. Differentiate between : BLASTA & FASTA 3. Explain the uses i=of Databases with special reference to PDB 4. Describe Bio-datamining.			
	MCQs for Internal Assessment (At least 8) 1. Which of the following is an example of Homology and similarity tool? (a) BLAST (b) RasMol (c) EMBOSS (d) PROSPECT Sol:(a) BLAST. 2. In which year did the SWISSPROT protein sequence database begin? (a) 1988 (b) 1985 (c) 1986			

(d) 1987
Sol:(d) 1987.

3.Which of the following scientists created the first Bioinformatics database?
(a) Dayhoff
(b) Pearson
(c) Richard Durbin
(d) Michael.J.Dunn
Sol:(a) Dayhoff.

4. The human genome contains approximately_____.
(a) 6 billion base pairs
(b) 5 billion base pairs
(c) 3 billion base pairs
(d) 4 billion base pairs
Sol: (c) 3 billion base pairs.

5. Which of the following tools is used for the identification of motifs?
(a) BLAST
(b) COPIA
(c) PROSPECT
(d) Pattern hunter
Sol: (b) COPIA.

6. The first molecular biology server expasy was in the year _____.
(a) 1992
(b) 1993
(c) 1994
(d) 1995
Sol: (b) 1993.

7. What is the deposition of cDNA into the inert structure called?
(a) DNA probes
(b) DNA polymerase
(c) DNA microarrays
(d) DNA fingerprinting
Sol: (c) DNA microarrays.

8. The identification of drugs through the genomic study is called_____.
(a) Genomics
(b) Pharmacogenomics
(c) Pharmacogenetics
(d) Cheminformatics
Sol: (b) Pharmacogenomics.

9. Which of the following are not the application of bioinformatics?
(a) Drug designing
(b) Data storage and management
(c) Understand the relationships between organisms
(d) None of the above
Sol: (d) None of the above.

10. Proteomics refers to the study of _____.
(a) Set of proteins in a specific region of the cell
(b) Biomolecules
(c) Set of proteins
(d) The entire set of expressed proteins in the cell
Sol: (d) The entire set of expressed proteins in the cell.

11. The process of finding the relative location of genes on a chromosome is called _____.
(a) Gene tracking
(b) Genome walking
(c) Genome mapping
(d) Chromosome walking

	Sol:(c) Genome mapping. 12. The computational methodology that tries to find the best matching between two molecules, a receptor and ligand are called _____. (a) Molecular fitting (b) Molecular matching (c) Molecular docking (d) Molecule affinity checking Sol: (c) Molecular docking.

Sant Gadge Baba Amravati University
FACULTY: Science and Technology
Teaching and Learning Scheme (Fundamentals in Immunology and Molecular Biology) for the Three Year UG Degree of Bachelor of Biotechnology
(Three Years- Six Semesters Bachelor's Degree Programme)

Course Template for Theory Curriculum: Developmental Biology

Each theory paper of **Theory shall be of 2 Credits comprising of 4 Units with Teaching Hours** as mentioned in the table. The pattern of theory papers shall be as per following template –

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
4.5	I	106402	Developmental Biology	2	30	2 Hrs	30

The Curriculum of any Course shall be designed as per following template:

Course Objectives:	CO 1. The objective of this course is to provide a comprehensive understanding of the concepts of early animal development. CO 2 Students taking this course must develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.			
Course Outcomes:	On the successful completion of the course, students will be able to- • Explain the molecular and genetic background of animal development. • Describe evolutionary history of complex multicellular life forms; • Compare environmental influence on development and homeostasis of animals . • Interpret, analyse and present experimental results and conclusions in a scientific manner.			
Unit System	**Contents**	**Workload Allotted (Hrs)**	**Weightage of Marks Allotted**	**Incorporation of Pedagogies**
Unit I	Gametogenesis and Fertilization 1.1 Definition, scope & historical perspective of development Biology 1.2 Gametogenesis –Spermatogenesis, Oogenesis 1.3 Fertilization - Definition, mechanism, types of fertilization.	8	8	BoS shall recommend suitable pedagogical strategies, both classical and contemporary innovations, for integration into the Teaching, Learning, and Evaluation (T, L, & E) Processes. These strategies should be tailored to enhance the delivery and

	1.4 Different types of eggs on the basis of yolk			comprehension of the course content within each Unit, ensuring that they align with the educational objectives and learning outcomes.
Unit II	Early embryonic development	7	7	
	2.1 Cleavage: Definition, types, patterns & mechanism .			
	2.2 Blastulation: Process, types & mechanism			
	2.3 Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination			
	2.4 Formation & differentiation of primary germ layers, Fate Maps in early embryos			
Unit III	Embryonic Differentiation	8	8	
	3.1 Differentiation: Cell commitment and determination			
	3.2 The epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level			
	3.3 Concept of embryonic induction: Primary, secondary &tertiary embryonic induction,			
	3.4. Neural induction and induction of vertebrate lens.			
Unit IV	Organogenesis	7	7	
	4.1 Neurulation, notogenesis, development of vertebrate eye.			
	4.2 Fate of different primary germ layers.			
	4.3 Development of behaviour: constancy & plasticity.			
	4.4 Extra embryonic membranes, placenta in Mammals.			

References

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