

“Education for Knowledge Science and Culture”

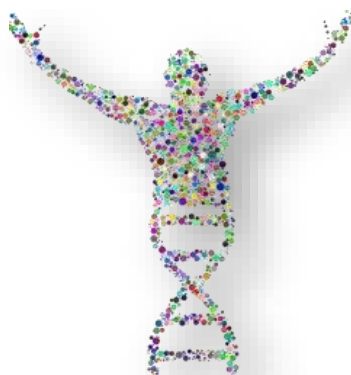
- Dr Bapuji Salunkhe



**Shri Swami Vivekanand
Shikshan Sanstha's**



VIVEKANAND COLLEGE
KOLHAPUR
(EMPOWERED & AUTONOMOUS),



Syllabus For
Bachelor of Science Part - I
BIOTECHNOLOGY(ENTIRE)
SEMESTER I AND II

(As per NEP 2020 Syllabus to be implemented from June, 2023 onwards)

For Bachelor of Science Part - I BIOTECHNOLOGY (Entire) to be implemented from June 2023

1. TITLE: Biotechnology-Entire

2. YEAR OF IMPLEMENTATION:- CBCS Syllabus will be implemented from June, 2023 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students at first year of three years of B.Sc. degree course. Students learn Biotechnology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research. The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER:

- 1) To make the students knowledgeable with respect to the subject and its practicable Applicability.
- 2) To promote understanding of basic and advanced concepts in Biotechnology.
- 3) To expose the students to various emerging areas of Biotechnology.
- 4) To prepare students for further studies, helping in their bright career in the subject.
- 5) To expose the students to different processes used in industries and in research field.
- 6) To prepare the students to accept the challenges in life sciences.
- 7) To develop skills required in various industries, research labs and in the field of human health.

5. DURATION

- **The course shall be three year full time course.**

6. PATTERN:-

Pattern of theory Examination will be Semester. Practical examination will be annual

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

3) OTHER FEATURES:

(A) LIBRARY:

Reference and Text Books, Journals and Periodicals, Reference Books. – List Attached

(B) LABORATORY SAFETY EQUIPMENT:

- 1) Fire extinguisher
- 2) First aid kit
- 3) Fumigation chamber
- 4) Stabilized power supply
- 5) Insulated wiring for electric supply.
- 6) Good valves & regulators for gas supply.
- 7) Operational manuals for instruments.
- 8) Emergency exits.

Vivekanand College, Kolhapur (Autonomous)
NEP-2020: Credit Framework for Department of Biotechnology Entire

Level	Sem	1-Major		2-Minor	3-OE	4-SEC	5-AEC, VEC, IKS			6-OJT, FP, CEP, CC, RP		Total Credits	
		Major		Minor	IDC/MDC/OE/GE	SEC	AEC (Language)	Value Education Courses (VEC)	IKS	CC	Summer Internship /Field Project/OJT		Research Project / Dissertation
		DSC	DSE	MIN	OEL								
4.5	I	DSC-I (2) (Biotechnology for human welfare-I) DSC-II (2) (Biochemistry-I) Practical-I (2) (Techniques in Biochemistry)		MIN-I (2) (Introduction to Microbial world) MIN-II (2) (Techniques in Microbiology) Practical-I (2) (Lab Exercises in Microbiology)	OE-I (2) (Bio-Instrumentation-I) OE-II (2) (Plant Sciences) Practical-I (2) (Techniques in Bioinstrumentation)		AEC-I (2) (Eng)	-	IKS(2) Introduction to IKS			-	
	Credits	4+2=6		4+2=6	4+2=6		2		2			-	22
	II	DSC-III (2) (Biotechnology for human welfare-II) DSC-IV (2) (Biochemistry-II) Practical-I (2) (Techniques in Biotechnology)		MIN-III (2) (Bacterial Cytology and Cultivation) MIN-IV (2) (Virology) Practical-I (2) (Techniques in Bacterial Cytology and Virology)	OE-III (2) (Ecology) OE-IV (2) (Animal Sciences) Practical-I (2) (Techniques in Plant and Animal Sciences)	SEC-I (2) (Basics in Cell Biology)	AEC-II (Eng) (2)					-	
	Credits	4+2=6		4+2=6	4+2=6		2					-	22
Credits		12		12	12	2	4		2				44
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor													

5.0	III	DSC-V (2) (Molecular Biology-I) DSC-VI (2) (Plant tissue Culture) Practical-II(4) (Techniques in Plant Tissue Culture and cell Biology)		MIN-V (2) (Microbial Genetics and Immunology) Practical-II(2) (Techniques in Immunology and Genetics)		SEC-II (2) (Metabolic Pathways-I) SEC-III (2) (Introduction to Bioinformatics)	AEC-III (Eng)(2)	VEC-I(2) Democracy VEC-II (2) Environmental Science				-	
	Credits	4+4=8		2+2=4		4	2	4				-	22
	IV	DSC-VII (2) (Molecular Biology-II) DSC-VIII (2) (Metabolic Pathways-II) Practical-III (4) (Techniques in Molecular Biology and Metabolic pathways)		MIN-VI (2) (Environmental Biotechnology) Practical-II(2) (Techniques in Environmental Biotechnology)		SEC-IV (2) Animal Tissue Culture SEC-V (2) Advances in Cell Biology	AEC-IV (Eng) (2)-	VEC-III (2) Environmental Science	CC (2)			-	
	Credits	4+4=8		2+2=4		4	2	2		2		-	22
Credits		16		8		8	4	6		2			44
Exit option: Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor													

5.5	V	DSC-IX (2) (Basics in Genetic Engineering) DSC-X (2) (Application of Biotechnology in Agriculture) DSC-XI (2) (Research Methodology in Biotechnology) DSC-XII (2) Enzymology	DSE-I (2) Biophysics	MIN-VII(2) (Industrial Biotechnology)	-			-		-	FP (2) Project	-	
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		Practical-IV (4) Techniques in Industrial Biotechnology Practical-IV (4) Techniques in Agriculture and health Biotechnology											
	Credits	8+8=16	2+0=2	2 +0=2				-			2		22
	VI	DSC- XIII (2) (Advances in genetic Engineering) DSC- XIV (2) (Application of Biotechnology in Health) DSC- XV (2) Advances in Bioinformatics DSC- XVI (2) (Bioethics, Bio safety and IPR) Practical- V (4) Techniques in Genetic engineering Practical- V (4) Techniques in Bioinformatics	DSE-II (2) Introduction Diagnostic techniques	MIN-VIII (2) (Fermentation Biotechnology)	-			-		-	OJT (2) Proje ct/Tra ining	-	
	Credits	8+8=16	2+0=2	2 +0=2				-			2		22
	Credits	32	4	4							4		44
		60/60	4	24/24 Minor	12/9 IDC/MDC/OE /GE	10/9 SEC	8/8 AEC	6/6 VEC	2/2 IKS	2/2 CC	4/4 FP+OJ T	-	132/ 132

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

Abb: DSC- Discipline Specific Core, DSE- Discipline Specific Elective, MIN-Minor, OEL- Open Elective, IDC: Inter-Disciplinary Course MDC: Multi-Disciplinary Course, GE: Generic Elective, SEC- Skill Enhancement Course, VSC: Vocational Skill Course, AEC- Ability Enhancement Course, VEC- Value Education Course, OJT: On-Job Training, FP: Field Project, CEP: Community Engagement Programme, CC: Co-curricular Courses, RP: Research Project

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Sr.No.	Name	Page No.
1.	B.Sc. I Biotechnology Entire (NEP 2020 Pattern)	
2.	Subject codes	
3.	Syllabus	
4.	Nature of Question paper	
5.	Scheme of marking	

Teaching and Evaluation scheme B.Sc- Biotechnology (Entire)
First Year Semester- I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	CA	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC07BTE11	Biotechnology-I (Biotechnology for human welfare-I)	2	-	40	10	-	50	2
2	DSC-II	DSC07BTE12	Biotechnology-II (Biochemistry-I)	2	-	40	10	-	50	2
3	MIN-I	MIN07BTE11	Microbiology-I (Introduction to Microbial world)	2	-	40	10	-	50	2
4	MIN-II	MIN07BTE12	Microbiology-II (Techniques in Microbiology)	2	-	40	10	-	50	2
5	OEC-I	OEC07BTE11	(Bio-Instrumentation-I)	2	-	40	10	-	50	2
6	OEC-II	OEC07BTE12	(Plant Sciences)	2	-	40	10	-	50	2
7	IKS	IKS07GEC11	Indian Knowledge System	2	-	50	-	-	50	2
8	AEC-I	AEC07ENG11	English	2	-	40	10	-	50	2
				16		330	70		400	16
Semester-II										
1	DSC-III	DSC07BTE21	Biotechnology -III (Biotechnology for human welfare-II)	2	-	40	10	-	50	2
2	DSC-IV	DSC07BTE22	Biotechnology-IV (Biochemistry-I)	2	-	40	10	-	50	2
3	MIN-III	MIN07BTE21	Microbiology-III (Bacterial Cytology and Cultivation)	2	-	40	10	-	50	2
4	MIN-IV	MIN07BTE22	Microbiology-IV (Virology)	2	-	40	10	-	50	2
5	OEC-III	OEC07BTE21	(Ecology)	2	-	40	10	-	50	2
6	OEC-IV	OEC07BTE22	(Animal Sciences)	2	-	40	10	-	50	2
7	SEC-I	SEC07BTE21	(Basics in Cell Biology)	2	-	40	10	-	50	2
8	AEC-II	AEC07ENG21	English	2	-	40	10	-	50	2
				16		320	80		400	16
Annual										
1	DSC-PR-I-A	DSC07BTE29	(Techniques in Biochemistry)	-	4	-	-	50	50	4
	DSC-PR-I-B		(Techniques in Biotechnology)							
2	MIN-PR-I-A	MIN07BTE29	(Lab Exercises in Microbiology)	-	4	-	-	50	50	4
	MIN-PR-I-A		(Techniques in Bacterial Cytology and Virology)							
3	OEC-PR-I-A	OEC07BTE29	(Techniques in Bioinstrumentation)	-	4	-	-	50	50	4
	OEC-PR-I-A		(Techniques in Plant and Animal Sciences)							
					12			150	150	12
	Total			32	12	650	150	150	950	44

* Note: Credit 1 for theory = 25 Marks

** Note: Credit 1 for Practicals = 12.5 Marks

PROGRAM OUTCOMES OF BIOTECHNOLOGY ENTIRE

PO1 Gain and apply fundamental practical and theoretical knowledge of all the disciplines in life sciences with emphasis on Biotechnology.

PO2 Think and evaluate critically, and provide solutions to problems using scientific methodology.

PO3 graduates will be able to understand the need and impact of Biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

PO4 graduates will be able to demonstrate scientific methodology and industrial management when dealing with pharmaceutical industries in Biotechnology.

PO5 Act in ethically righteous manner in scientific, conducting and communicating the research and always keep in mind the ethos of our society.

B.Sc-I Entire Biotechnology NEP PO's and CO's

Subject Offered Semester-I	Course Outcome
DSC07BTE11- Biotechnology-I Biotechnology for Human welfare - I	At the end of this course students will be able to: CO 1. To enumerate the importance of Biotechnology in Human Development. CO 2. To learn the different aspect of Biotechnology. CO 3. Understand the importance of Biotechnology in health. CO 4.To learn the techniques of production of Biofertilizer.
DSC07BTE12- Biotechnology-II Biochemistry-I	At the end of this course students will be able to: CO 1. Understand basic concepts of origin of life CO 2. Outline the importance of carbohydrates and lipids in the diet. CO 3.understand the basic concepts of biological buffer system. CO 4. Predict and illustrate sap value, iodine value, and acid value.
MIN07BTE11-Microbiology-I- Introduction to Microbial World.	At the end of this course students will be able to: CO 1. Choose specific staining techniques for various types of Microorganisms. CO 2 explain different methods required for sterilization CO 3. Understand the bacterial bacterial taxonomy CO 4.understand nutritional requirements of bacteria.
MIN07BTE12-Microbiology-II- Techniques in Microbiology.	At the end of the course students will be able to : CO 1. Acquire the Knowledge about the isolation of microorganism in pure culture from mixed population. CO 2. To carry out microbiological analysis of water CO 3. To conclude Different modes of transmission of diseases. CO 4.
OEC07BTE11- Bio- Instrumentation	At the end of this course students will be able to: CO 1. Illustrate different methods of protein purification CO 2. Demonstrate and use different lab instruments CO 3 understand basic concepts of spectroscopy CO 4. Perceive the knowledge about different types of microscopy.
OEC07BTE12- Plant Sciences	At the end of this course students will be able to: CO 1. Understand general classification of plant kingdom CO 2.explain the terms used in plant morphology and taxonomy CO 3.outline the general characters of Algae, Bryophytes etc. CO 4.explain the rules of taxonomy.

Subjects offered Semester-II	Course Outcomes
DDC07BTE21-Biotechnology-III- Biotechnology for Human welfare- II	At the end of this course students will be able to: CO 1. Acquire the knowledge about importance of biotechnology. CO 2. Acquire the knowledge about applications of biotechnology in commercial products. CO 3. Understand the importance of Biotechnology in plant and animal cell cultivation. CO 4. Acquire the knowledge about applications of biotechnology in conservation and environment.
DSC07BTE22-Biotechnology -IV Biochemistry-II	At the end of this course students will be able to: CO 1 Classify different types of proteins. CO 2. Elaborate the role of chromatography in purification of bimolecule. CO 3. Describe the functions of different coenzymes. CO4. Explain IUB classification of enzymes.
MIN07BTE21-Microbiology-III- Bacterial Cytology & Cultivation.	At the end of this course students will be able to: CO 1. Acquire the Knowledge about the isolation of microorganism in pure culture from mixed population. CO 2. To carry out microbiological analysis of water CO 3. To conclude Different modes of transmission of
MIN07BTE22-Microbiology-IV- Virology	At the end of this course students will be able to: CO.1. Elucidate different structure of viruses. CO.2. Demonstrate experimental procedure for cultivation of viruses. CO. 3. Compare the replication of viruses. CO.4. Understanding the infection cycle of viruses.
OEC07BTE21-Ecology	At the end of this course students will be able to: CO1:- Appreciate the ethical, cross-cultural and historical context of environment with respect to classical ecology. CO2:- Construct the relationship between different biogeochemical cycles. CO3:- Outline the importance of Population ecology. CO4:- Reflect the importance of Evolution theories in ecology.
OEC07BTE22-Animal Science	At the end of this course students will be able to: CO 1. Understanding the diversity of life. CO 2. Reflect the importance of host parasite relationship CO 3. Explain the structure and functions of different types of tissue. CO4. Encourage the students to opt for carrier in applied zoology.
SEC07BTE21-Basics in cell biology	At the end of this course students will be able to: CO 1.Percieve knowledge about the cell theory CO 2. Explain concept of types of membrane transport. CO 3.Understanding functions of different cell organelles

Semester - I**Sub code - DSC07BTE11 Biotechnology-I
(Biotechnology for Human Welfare-I) (Credit-2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit I</p> <p>Introduction to Biotechnology: Biotechnology-Origin and definition, History of Biotechnology, Biotechnology as interdisciplinary area, Scope and importance of Biotechnology, Branches of Biotechnology in India, Examples of CSIR Institutes labs in India, Commercial potential of Biotechnology, Achievements of Biotechnology, Prevention of Misuse of Biotechnology, Future of Biotechnology.</p> <p>Interaction between plants and microbes, transfer of paste resistance genes to plants: Biofertilizer -Definition ,types with examples, Mass production and field application and use of – <i>Azotobacter</i>, <i>Rhizobium</i>, <i>Azospirillum</i> Biopesticide – Definition ,types with examples production and applications of Bacterial (<i>Bacillus thuringensis</i>) and fungal (<i>Trichoderma</i>) Biopesticides</p>	15
Credit - II		
2.	<p>Health Biotechnology: Gene Therapy- concept, advantages and disadvantages. Vaccines- concept, types of vaccines examples, recombinant vaccines example and uses. Stem Cells- Characteristics, types and applications.</p> <p>Forensic science- History of Forensic: Global history and development of forensic science, Sir Alec Jeffrey's Important Contribution. Introduction to Forensic science – Nature, basics of Forensic Science, Forensic Laboratory: Divisions of forensic science laboratory- Physics, chemistry, biology, Serology, Toxicology, Questioned Document division, Digital and Cyber division, Evidence collection division. Organization Structure, important instruments and tools and techniques.</p>	15

References:

1. B.B. Nanda and R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty First Century*, Select Publishers, New Delhi (2001). _
2. M.K. Bhasin and S. Nath, *Role of Forensic Science in the New Millennium*, University of Delhi, Delhi (2002). _
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. *Biotechnology* – U. Satyanarayana
5. *Medical biotechnology* – S. N. Jogdand
6. *Advances in Biotechnology*- S.N.Jogadand
7. *A textbook of Biotechnology* - R. C. Dubey
8. *Pharmaceutical Biotechnology* – S. P. Vyas ,V. K. Dixit
9. *Biotchnology* – B. D. Singh
10. *Fundamentals of agriculture biotechnology* – S. S. Purohit
11. *Agricultutre application of Microbiology*- Neelima Rajvaidya.

**Sub code - DSC07BTE12 Biotechnology-II
(Biochemistry-I) (Credit-2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit – I</p> <p>Origin of life: - Basic concept, A.I. Oparin concept, Urey Miller's experiment, Introduction to Biomolecules - Carbohydrate, Protein, Lipid, Nucleic Acid</p> <p>Properties of water: Interactions in aqueous systems. Ionization of water, weak acid weak bases. Ionic Product of Water</p> <p>Pⁿ, pka value definition, H-H Equation, Titration Curve of Amino Acid</p> <p>Biological Buffer Systems- e.g. Phosphate, Bicarbonate, Haemoglobin buffer system, Protein buffer system</p> <p>Nucleic acids: Nucleosides, nucleotides, polynucleotide, DNA and its different forms with properties. (A, B, D, & Z), RNA and its types- m-RNA, t-RNA, r-RNA Forces Stabilizing nucleic acid structure.</p>	15
2.	<p style="text-align: center;">Credit - II</p> <p>Carbohydrates: Classification, glyceraldehydes, simple aldoses & ketoses ,open and Ring Structure of Aldoses and Ketoses, Confirmation of D-glucose, biological importance of carbohydrates, reactions of monosaccharide (Oxidation, reduction, Osazone), glycosidic bond, disaccharides (Sucrose, maltose, lactose), polysaccharides - homo polysaccharides, e.g. Starch, glycogen, Cellulose. Mutarotation of Glucose</p> <p>Lipids: Classification, Simple lipid - Triacyl glycerol & waxes. Compound lipid - Phospholipid, e.g. - Phosphotidylcholine, ethanolamine, Sphingolipids, e.g. Sphingomyelin, cerebrosides, gangliosides.</p> <p>Physical properties,- state, colour, odour, melting point, solubility, specific gravity, geometric isomerism, insulation, emulsification , surface tension.</p> <p>Chemical properties- sap value, acid value, iodine no., rancidity; Derived lipid- Cholesterol, lipoprotein - LDL, VLDL, HDL, Chylomicrons. Liposome.</p>	15

References:-

- 1) *Biochemistry – Nelson & Cox*
- 2) *Biochemistry - Stryer*
- 3) *Enzymes - Trevor Palmer*
- 4) *Biochemistry - Voiet & Voiet*
- 5) *Biochemistry - J. L. Jain*
- 7) *Biochemistry - Powar and Chatwal*
- 8) *Protein Purification- Harris and Angel*
- 9) *Principles of Biochemistry - T. N. Pattabriraman.*
- 10) *Biochemistry 3rd Edition – Hames & Hopper.*
- 11) *General Biochemistry – J. H. Well.*
- 12) *Biochemistry – J. H. Ottaway & D. K. Apps*
- 13) *Biochemistry – U. Satyanarayanan*

**Sub code - MIN07BTE11 (2) Microbiology-I
(Introduction to Microbial world)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit –I</p> <p>Development of microbiology as a discipline – Biogenesis Vs Abiogenesis. Ubiquitous nature of microbial life. Development from simple to complex life form.</p> <p>Significance of Scientific contributions in development in Microbiology as a discipline:</p> <p>A. Early contributions Robert Hook, Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall.</p> <p>B. Scientific contribution leading to diversification of Microbiology</p> <p>i. Medical Microbiology and Immunology- Edward Jenner, Paul Ehrlich, Ellie Metchnikoff, Lister.</p> <p>ii. Food Microbiology and Fermentation- Alexander Fleming, Louis Pasteur, Selman Waksman</p> <p>iii. Soil Microbiology- Winogradsky, Martinus Beijerinck</p> <p>iv. Microbial Genetics – Watson and Crick, Hargobind Khurana, Griffith, Avery, McCarty, and Macloed.</p> <p>Beneficial and harmful activities of microorganisms in – Medical, Environmental, Food, Agriculture, Industrial microbiology</p> <p>Applied branches of Microbiology and major microbiological institutes in India.</p>	15
2.	<p style="text-align: center;">Credit – II</p> <p>Diversity of Microbial World:</p> <p>A. Systematic of Classification- Binomial nomenclature, three kingdom, five kingdom classification and utility.</p> <p>Bacterial taxonomy: General principles of bacterial nomenclature - a) Taxonomic ranks, b) Common or Vernacular name, c) Scientific or International name, Criteria for bacterial classification- Morphological, cultural, biochemical & serological characters, Concept of bacterial species & strain. Introduction to Bergey’s manual of systematic bacteriology.</p> <p>B. Differences in Cellular and Acellular microorganisms Differences in prokaryotic and eukaryotic (Occurrence, morphology, mode of reproduction and economic importance)</p> <p>C. Different groups microorganisms- Bacteria, Yeast, Fungi, Actinomycetes, Algae, Viruses, Protozoa, Viroids and Prions</p>	15

References:

- 1) *General Microbiology-Stanier*
- 2) *Introduction to Microbiology-Ingraham*
- 3) *Brock biology of Microorganisms-Madigan et al*
- 4) *Fundamentals of Microbiology-Frobisher*

5) *Microbiology-Pelczar*

6) *General Microbiology –Pawar & Daginawala*

Sub code - MIN07BTE12 Microbiology-II

(Techniques in Microbiology)

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit I</p> <p>Concept of Sterilization:- Definitions of: Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Asepsis, Sanitization. Methods of sterilization by- a) Physical agents: i) temperature-dry heat, moist heat ii) Radiation- U.V, Gamma radiation iii) Bacteria proof filter- membrane filter. b) Chemical agents: - Phenol & Phenolic compounds, Alcohol, Heavy metals (e.g. mercury). c) Gaseous agents- Ethylene oxide, formaldehyde Checking efficiency of sterilization- biological and chemical indicator Checking efficiency of Disinfection- Phenol coefficient- Rideal Walker coefficient, Chick Martin Test.</p>	15
2.	<p style="text-align: center;">Credit II</p> <p>Microscopy and Staining Techniques Microscopy: Microscopy a) General principles of microscopy- Image formation, magnification, numerical aperture (Uses of oil immersion objective), resolving power of microscope and working distance. b) Ray diagram, special features, applications and comparative study of compound microscope and Electron Microscope (Scanning and Transmission Electron Microscope). Stains and staining procedures - Definition of dye and stain, Classification of stains – Acidic, Basic and Neutral, Principles, Procedure, Mechanism and application of staining, Procedures - i) Simple staining, ii) Negative staining, iii) Differential staining : Gram staining and Acid fast staining, iv) Special staining: Capsule staining, cell wall staining, endospore staining</p>	15

References:

1) *General Microbiology-Stanier*

2) *Introduction to Microbiology-Ingraham*

3) *Brock biology of Microorganisms-Madigan et al*

4) *Fundamentals of Microbiology-Frobisher*

5) *Microbiology-Pelczar*

6) *General Microbiology –Pawar & Daginawala*

**Sub code - OEC07BTE11 Open Elective-I
(Bio-Instrumentation-I) (Credit 2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit - I</p> <p>Method of cell disruption: Blenders- grinding with abrasives, presses, enzymatic method, sonication; Salt participation- Salting in, salting out, organic solvent precipitation, dialysis, ultra filtration.</p> <p>Centrifugation- Basic principles, RCF, Sedimentation coefficient, Svedberg's constant, Types of centrifuge: Desktop, High speed and Ultracentrifuge, Preparative centrifugation: Differential and density gradient centrifugation.</p> <p>Basic Laboratory Instruments: Introduction, Principle and applications of electrophoresis-Supporting media- Agarose, PAGE. Construction & Working pH meter, Autoclave, Laminar Air Flow.</p>	15
2.	<p style="text-align: center;">Credit II</p> <p>Microscopy : History, Terms in microscopy – Magnification, Refractive index, Numerical aperture, Resolving power Principle, working, ray diagram and applications of</p> <ol style="list-style-type: none"> 1. Bright field microscopy 2. Dark field microscopy 3. Phase contrast microscopy 4. Fluorescence microscopy <p>Colorimeter Principle, Instrumentation and working, Lambert-Beer's law derivation.</p> <p>UV-Visible Spectroscopy Introduction to spectroscopy, properties of electromagnetic radiation UV and Visible range. Principle, Instrumentation and Applications of UV and Visible spectrophotometer</p>	15

References:-

- 1) *Biophysical Chemistry by Nath and Upadhy.*
- 2) *Practical biochemistry principles and techniques by Wilson and Walker.*
- 3) *Instrumental methods of chemical analysis by Chatwal and Anand.*
- 4) *Lab Manual in Biochemistry by J. Jayaraman.*
- 5) *Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.*
- 6) *Analytical Biochemistry by Holme.*
- 7) *Spectroscopy by B.P. Straughan and S. Walker*
- 8) *Introduction to HPLC by R.J. Hamilton and P.A. Sewell*

**Sub code - OEC07BTE12 Open Elective-II
(Plant Sciences) (Credit 2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">CREDIT -I</p> <p>Plant Diversity Outline of General Classification of Plant Kingdom. Algae – General characters and economic importance Fungi – General characters and economic importance Lichens -General account and economic importance Bryophytes – General characters and economic importance Pteridophytes – General characters and economic importance Gymnosperms – General characters and economic importance Angiosperms – General characters and economic importance</p> <p>Taxonomy of Angiosperms Taxonomy :- Definition, Aims, objectives and functions, Binomial nomenclature and its significance, Categorize of plant species as per IUCN, Methods of conservation, study of Outline of Bentham & Hookers System of classification of plants.</p>	15
2.	<p style="text-align: center;">Credit II</p> <p>Vegetative Reproduction – Cutting, Grafting, Tissue Culture. Sexual Reproduction in Angiosperms:- Structure of Typical Flower – Floral whorls and functions, Structure of anther and Ovule, Fertilization: - Definition, Double fertilization and its significance, Pollen- Pistil Interaction, Apomixis. Self incompatibility. Development of Endosperm and Embryo Mono and Dicot. Fruit - Definition, formation, Types: a) Simple, b) Aggregate, c) Composite. Seed – Definition and its types, Dormancy of seed- Definition, Causes and Breaking of seed dormancy, Seed germination- Concept, Types- Epigeal and Hypogeal, factors affecting seed germination. Plant Anatomy, Tissues- Simple and complex (Xylem and Phloem) Meristem its types and functions.</p>	15

Reference Books:

- 1) Devlin R.M. *Fundamentals of plant physiology* (MacMillan)
- 2) Malik C.P. *Plant physiology*, Kalyani publishers
- 3) Dube H.C. *Text of fungi, bacteria and viruses.*
- 4) Bold H.C. *The Plant kingdom*, Prentice - Hall India
- 5) Chopra G.L. i. *Class book of algae*, ii. *Class book of fungi*
- 6) Dutta A.C. *A Class book of botany*, Oxford University Press
- 7) Kumar H.D. *Biodiversity and sustainable development* (Oxford & IBH)
- 8) Mukherji H. *Plant groups* (New central book depot)
- 9) Parihar N.S. *An Introduction to embryophyta* (Central book depot)
- 10) Vasishtha P.C. *Botany for degree students-Gymnosperms*
- 11) Naik V.N. *Taxonomy of angiosperms*
- 12) Lawrence G.H. *Taxonomy of flowering plants*
- 13) Chopra G.L. *Angiosperms (Systematic and life cycle)*
- 14) Shivarajan V.V. *Introduction to principles of taxonomy.*
- 15) Pandey B.P. *Text book of angiosperms*
- 16) Eames A.J. and An introduction of plant anatomy, Mac Daniels L.H.
- 17) Esau K. *Anatomy of seed plants*
- 18) Esau K. *Plant anatomy*
- 19) Fahn A. *Plant anatomy*
- 20) Mathur R.C. *Systematic botany*

Semester- II
Sub code - DSC07BTE21 Biotechnology -III
(Biotechnology for Human Welfare-II) (Credit 2)

Sr No.	Units	Lecture (30)
1.	<p style="text-align: center;">Credit I</p> <p>Agriculture Biotechnology- Biotechnology in crop improvement, selection of crop for biotic- abiotic stress resistance, Metabolite engineering, Genetically Modified Crop- Golden rice, herbicide resistance, insect resistance, disease resistance, bio-fortification and nutrition enhancement, bio energy crops</p> <p>Cell Culture – Animal cell culture – Introduction, history and requirement for ATC lab, characteristics of animal cell growth in culture, sterilization and types of media, Applications. Plant cell culture – introduction, history and requirement for PTC lab, sterilization and types of media, Micro propagation – stages of micro propagation Applications.</p>	15
2.	<p>Applied biotechnology - Environment – Bioremediation- degradation of hydrocarbons and agriculture waste, Phyto remediation, Bioleaching, bio sorption. Conservation Biotechnology – Role of biotechnology in conservation, need for conservation, use of genetically modified organism, DNA hybridization, bar-coding and its use in identification and conservation, antipoaching FOOD biotechnology- Single cell protein (SCP) – <i>Spirullina</i> Concept of probiotics – history, mechanism of action, types, probiotics products in India, global scenario of probiotics, caution about probiotics. Prebiotics, synbiotics. Mushroom cultivation.</p>	15

References:

1. B.B. Nanda and R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty First Century*, Select Publishers, New Delhi (2001). _
2. M.K. Bhasin and S. Nath, *Role of Forensic Science in the New Millennium*, University of Delhi, Delhi (2002). _
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. *Biotechnology – U. Satyanarayana*
5. *Medical biotechnology – S. N. Jogdand*
6. *Advances in Biotechnology- S.N. Jogadand*
7. *A textbook of Biotechnology – R. C. Dubey*
8. *Pharmaceutical Biotechnology – S. P. Vyas, V. K. Dixit*
9. *Biotechnology – B. D. Singh*

**Sub code - DSC07BTE22 Biotechnology -IV
(Biochemistry-II)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit – I</p> <p>Protein: Amino acid classification (Depending upon R group), structure of amino acids, single letter codes of amino acids, peptide bond, classification of protein based on composition - Simple ,conjugate, derived. Determination of primary structure (Sanger’s method, Edman’s method, Dansylchloride), structural level organisation of proteins- Primary ,Secondary- forces stabilizing secondary structure types – α – helix, β-sheets, Ramachandran plot. Tertiary structure (Describe different bonds), w.r.t. Myoglobin. Quaternary structure w.r.t. Hemoglobin. Biological functions of Proteins.</p> <p>Chromatography : Introduction, Theory, Principle and applications of Thin layer chromatography, paper chromatography, column chromatography, size exclusion chromatography, Ion exchange chromatography, Affinity chromatography.</p>	15
2.	<p style="text-align: center;">Credit – II</p> <p>Enzymes: Introduction, IUB classification, active site, energy of activation, transition state hypothesis, lock and key hypothesis, Induced fit hypothesis, enzyme inhibition- types competitive, non-competitive, un-competitive. M-M equation, Line weaver-Burk plot</p> <p>Vitamins and Co-enzymes: Classification, water-soluble (Vitamin B complex Vitamin C) and fat-soluble vitamins (Vitamin A, E, D and K). Structure, dietary requirements, deficiency conditions, coenzyme forms and their mechanism.</p>	15

References:-

- 1) *Biochemistry – Nelson & Cox*
- 2) *Biochemistry – Stryer*
- 3) *Enzymes – Trevor Palmer*
- 4) *Biochemistry – Voiet & Voiet*
- 5) *Biochemistry – J.L.Jain*
- 6) *Basic Biophysics- M. Daniel*
- 7) *Biochemistry – Powar and Chatwal*
- 8) *Protein Purification- Harris and Angel*
- 9) *Practical biochemistry – Keith Wilson And Walker*

**MIN07BTE21 Microbiology-III
(Bacterial Cytology and Cultivation) (Credits-2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit –I</p> <p>Morphology and cytology of Bacteria Morphology of Bacteria – i) Size, ii) Shape, iii) Arrangements Cytology of Bacteria –</p> <p>1. Cell wall: Composition and detailed structure of Gram positive and Gram negative cell walls, archaeobacterial cell wall, Lipopolysaccharide, Sphaeroplasts, protoplasts and L: forms. Effect of antibiotics and enzymes on the cell wall</p> <p>2. Cell membrane : Structure , function and chemical composition of bacterial and archael cell membranes</p> <p>3. Endospore :Structure , formation and stages of sporulation</p> <p>4. Capsule : Structure , composition and function</p> <p>5. Flagella : Structure , composition and function</p> <p>6. Fimbriae and pili : structure , composition and function</p> <p>7. Cytoplasm : Ribosomes, mesosomes, nucleoid, chromosome and plasmids, Cell inclusion - gas vesicles, carboxysomes , PHB granules , metachromatic granules and glycogen bodies</p>	15
2.	<p style="text-align: center;">Credit – II</p> <p>Microbial nutrition Nutritional requirements of microorganisms : Water; Micronutrients; Macronutrients; Carbon, Energy source; Oxygen and Hydrogen; Nitrogen, Sulphur and Phosphorous and growth factors- auxotroph, prototroph and fastidious organisms. Nutritional types of microorganism based on carbon and energy sources - a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs, e. Photoautotrophs f. Chemoautotrophsg .Photoheterotrophs, h. Chemoheterotrophs.</p> <p>Culture media and pure culture techniques: Common components of media and their functions Peptone, Yeast extract, NaCl, Agar and Sugar. Culture media – a) Living Media (Lab. Animals, plants, bacteria, embryonated eggs, tissue cultures), b) Non living media – i) Natural, ii) Synthetic, iii) Semisynthetic, iv) Differential, v) Enriched, vi) Enrichment, vii) Selective.</p> <p>Methods for isolation of pure culture – i) Streak plate ii) Pour plate iii) Spread plate</p> <p>Microbial growth: Definition of growth, phases & growth curve – a] Continuous culture, b] Synchronous growth, c] Diauxic growth Effect of environmental factors on growth-temperature, pH., osmotic pressure, hydrostatic pressure, surface tension, heavy metals, ultraviolet light.</p>	15

References:

- 1) *General microbiology-Stanier*
- 2) *Introduction to microbiology-Ingraham*
- 3) *Brock biology of microorganisms-Madigan etal*
- 4) *Fundamentals of microbiology-Frobisher*
- 5) *Microbiology-Pelczar*
- 6) *General microbiology -Pawar&Daginawala*
- 7) *Text book of microbiology-Ananthanarayan & panikar*

**MIN07BTE22 Microbiology –IV
(Virology) (Credits-2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit-I</p> <p>General Virology:</p> <p>A. History, Origin and Evolution of viruses</p> <p>B. General characteristics of Viruses</p> <p>C. Structure of viruses</p> <p style="padding-left: 20px;">i Enveloped and Non enveloped viruses</p> <p style="padding-left: 20px;">ii. Capsid symmetries – Icosohedral and Helical</p> <p style="padding-left: 20px;">iii. Structural components of virus – Protein - Envelope proteins, Matrix proteins and Lipoproteins, Genome – dsDNA, ssDNA, dsRNA, ssRNA (positive sense, negative sense and ambisense), linear, circular, segmented</p> <p>D. Classification & nomenclature of viruses</p> <p style="padding-left: 20px;">i. ICTV nomenclature</p> <p style="padding-left: 20px;">ii. Baltimore classification</p>	15
2.	<p style="text-align: center;">Credit-II</p> <p>A. Isolation, Cultivation, Purification and Enumeration of Viruses</p> <p style="padding-left: 20px;">i. Isolation and cultivation of viruses- Bacteriophages, Animal viruses, Plant viruses</p> <p style="padding-left: 20px;">ii. Purification of viruses- Centrifugation and precipitation</p> <p style="padding-left: 20px;">iii. Enumeration of viruses- Direct and Indirect method</p> <p>B. Replication of viruses:</p> <p style="padding-left: 20px;">i. Bacteriophages – T4 phage (Lytic), Lambada phage(Lytic and lysogeny)</p> <p style="padding-left: 20px;">ii. Plant viruses – TMV</p> <p style="padding-left: 20px;">iii. Animal viruses – HIV, nCoV, HPV</p>	15

References:

1. Burton E. Tropp (2008). *Molecular Biology Genes to proteins* (3rd edition).
2. Bartlett Publishers. Hull R (2002) *Matthew's Plant Virology*, 4th edition. Academic Press.
3. Mahy B. WJ. And Kangro H.O., (1996), *Virology Methods Manual*, Academic Press.
4. Dimmock N. J. et al. (2007). *Introduction to modern virology* 6th edition. Blackwell Publishing.
5. Peter. J. Russell (2011). *iGenetics- molecular approach*. Pearson Education.
6. Hull R (2002) *Matthew's Plant Virology*, 4th edition. Academic Press.
7. Gibbs Adrian & Bryan Harrison, *Plant Virology -The Principles*. Edward Arnold Press.
8. Strauss J. H. and Strauss E. G. (2002), *Viruses and Human Disease*, Academic Press
9. Knipe David M., Peter M. Howley, Diane E. Griffin, Robert A. Lamb, Malcolm A. Martin, Bernard Roizman, Stephen E. Straus, (2007), *Field's Virology*, 5th Ed. Lippincott Williams & Wilkins

OEC07BTE21 Open Elective -III (Ecology) (Credit 2)

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit -I</p> <p>Ecosystem- Concept, structure, function. Productivity- Kinds of productivity. Food chain- types of food chain, food web, concept of trophic level, Ecological pyramids- concepts and types. Energy flow in ecosystem –concept of energy, unit of energy, ecological energetics, laws governing energy transformation, ecological efficiency, Biogeochemical cycle Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorus cycle Biodiversity Types of biodiversity, causes of loss of biodiversity, conservation of biodiversity, importance of biodiversity, Hot Spots.</p>	15
2.	<p style="text-align: center;">Credit II</p> <p>Population Ecology- Introduction, population characteristics, Natality, Mortality, survivorship curves, age structure, age pyramid. Population growth- Exponential and logistic, r and k strategists. Evolution :- Theories of evolution-Lamarckism, Darwinism, Modern synthetic theory & mutational theory. Evidences of evolution and Adaptive radiation. Concept of species and speciation. Hardy-Weinberg law and Equation.</p>	15

References:

1. *Fundamentals of ecology* ; E.P Odum.
2. *Concept of ecology* ; Dash.
3. *Environmental Biology*, Verma & Agarwal
4. *Environmental Science.*, Saigo, Canninhham
5. *General ecology.*, H.D.Kumar

OEC07BTE22 Open Elective –IV (Animal Sciences) (Credit 2)

Sr No.	Units	Lectures (30)
1.	<p>Structure and function of male reproductive system: Testis, hormonal regulation of spermatogenesis and spermiogenesis, inhibin and androgen binding proteins; capacitation of spermatozoa.</p> <p>Structure and function of female reproductive system: Ovary, influence of hormones On development!of ovarian follicles and oogenesis, reproductive cycles: estrous and! menstrual cycle,ovulation, atresia and corpus luteum formation; pregnancy and lactation; implantation and placentation</p> <p>Reproductive Health Infertility in male and female: causes, diagnosis and management.</p> <p>Sex determination: Chromosomal sex determination in mammals And Drosophila.</p>	15
2.	<p style="text-align: center;">Credit – II</p> <p>Basic concepts of development: Potency, commitment, specification(autonomous,regulativeand!syncytial),!induction, competence,determination and differentiation, morphogenetic gradients, cell fate and cell lineages, genomicequivalence and the cytoplasmic determinants, imprinting</p> <p>Cleavage and Early embryonic development:!Patterns and molecular mechanism of cleavage,blastula formation,gastrulation patterns,concept and functions of primary organizer, neural induction, differential gene expression during formation of germ layers.</p> <p>Morphogenesis and organogenesis in animals: Axes and pattern formation in Drosophila, amphibia and chick, derivatives of ectoderm, mesoderm and endoderm. Organogenesis - vulva formation in Caenorhabditis elegans; eye lens formation, formation of somite, limb development.</p> <p>Regeneration :Definition, mechanism, factors affecting regeneration.</p>	15

References :

1. Austin, C.R. and Short, R.V. *reproduction in Mammals. Cambridge University Press.*
2. Degroot, L.J. and Jameson, J.L. (eds). *Endocrinology. W.B. Saunders and Company.*
- Knobil, E. et al. (eds). *The Physiology of Reproduction. Raven Press Ltd.*
3. Gilbert, S. F. (2006). *Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.*

**SEC07BTE21 Skill Enhancement course
(Basics in Cell Biology) (Credit 2)**

Sr No.	Units	Lectures (30)
1.	<p style="text-align: center;">Credit -I</p> <p>Cell Structure – Discovery of Cell, Cell theory - Definition, discovery, three assumptions of cell theory, exceptions, organismal theory, protoplasm theory, Organization of Prokaryotic cell, Organization of Eukaryotic cell (plant and animal cell), Ultra structure & functions of cell organelles Mitochondria, Chloroplast, E.R., Golgi apparatus ,Lysosome, Peroxisome, Ribosomes. Cell membrane & Membrane transport, Cell membrane – components, Molecular models of cell membrane-Unit membrane model, Protein, crystal model, fluid mosaic model, Types of membrane transport, Passive transport-simple diffusion, facilitated diffusion, osmosis. Active transport-primary and secondary transport, Sodium pump, Na⁺-K⁺ ATPase pump, Bulk transport-endocytosis and exocytosis</p>	15
2.	<p style="text-align: center;">Credit - II</p> <p>Nucleus -Introduction, morphology, occurrence, shape, size, number, position Ultra structure of nucleus-Nuclear membrane, nucleoplasm, nucleopore complex, nucleus. Chromosome structure - introduction, General features of Prokaryotic chromosome. General features of Eukaryotic chromosome-. Chromosome number, size, Chromosomal nomenclature & General structure</p> <p>Cytoskeleton assembly Introduction, Cytoskeleton elements, Microtubules- occurrence, structure, chemical composition, microtubule associated proteins, functions, Microfilaments- occurrence, structure, chemical composition, functions, Intermediate filaments(IF) - occurrence, structure, chemical composition, types of IF, functions Organization of cilia and flagella</p>	15

References:-

- 1) *Molecular biology of cell-Albert*
- 2) *Molecular biology & cell biology – Lodish et al*
- 3) *Cell biology –De Robertis*
- 4) *Cell biology-Genetics, molecular biology-P.S. Warma & Agarwal*
- 5) *Genes Lewin*
- 6) *Cell biology –Gerald karp*
- 7) *Practical biochemistry – Keith, Wilson and Walker*
- 8) *Cell Biology- C.B.Pawar*

Practical code - DSC07BTEP1 (Credit 2)
(Techniques in Biotechnology)

Sr. No.	Name of the Practical	Practicals
1)	Extraction of proteins by Ammonium Sulphate Precipitation	1
2)	Demonstration of Working in Plant Tissue Culture Laboratory	1
3)	Determination of SPC of Biofertilizer samples	1
4)	Demonstration of Commercial Biofertilizer- Solid	1
5)	Isolation of DNA from Bone/Hair	1
6)	Demonstration (Principle, working, construction) of PCR	1
7)	Demonstration (Principle, working, construction) of Spectrophotometer	1
8)	Identification of Isolated Probiotic from Commercial product.	1

References:

- 1. Practical Biochemistry - J. Jayaraman*
- 2. Practical Biochemistry - David Plummer*

Practical code - DSC07BTEP1 (Credit 2)

(Techniques in Biochemistry)

Sr. No.	Name of the Practical	Practical
	Biochemistry- Major experiments	
1	Estimation of Glucose(500 ug/ml) by DNSA method 6 tubes- Graphical)	1
2	Estimation of Protein by Biuret Method 6 tubes- Graphical) e.g- Casein - 5mg/ml	1
3	Estimation of Reducing sugar from apple juice by Benedict' method - Quantitatively.	1
4	Isolation and characterisation of Starch from Potato.	1
	Biochemistry Minor Experiments	1
1	General -Qualitative tests for carbohydrates and detection of carbohydrate from given mixture(Glucose, fructose, maltose, xylose, sucrose, starch)	1
2	General -Qualitative tests for Amino acids and detection of Amino acid from given mixture (Arginine, methionine, cystine, tyrosine, tryptophan, histidine)	1
3	Separation and detection of Amino acid by Paper or Thin layer chromatography and Biomolecules by Gel filtration chromatography	1
4	Isolation and characterisation of Casein from Milk	1

References:

1. *Practical Biochemistry - J. Jayaraman,*
2. *Practical Biochemistry - David Plummer*

Practical code - MIN07BTEP2 (Credit 2)
(Lab Exercises in Microbiology)

Sr. No.	Name of the Practical	Practicals
1)	Microscopic examination of bacteria by a. Monochrome staining. b. Gram staining c. Negative staining. d. Capsule staining. e. Cell wall staining. f. Endospore staining	6
2)	Mounting and identification of Mold. a) Aspergillus b) Penicillium	2
3)	Preparation of bacteriological culture media i) Peptone water. ii) Nutrient broth. iii) Nutrient agar. iv) Mac Conkey's agar.	2
4)	Preparation of Fungal culture media i) Sabouraud's agar ii) PDA	2
5)	Enumeration of bacteria by total viable count from soil by spread plate technique and pour plate technique	2
6)	Observation of motility by hanging drop technique.	1
7)	Study of growth curve of bacteria	1

References:

- 1. Experimental Microbiology - Patel*
- 2. Media Preparation - Dr. A.M. Deshmukh*
- 3. Bacteriological Techniques - F. J. Baker*

Practical code - MIN07BTEP2 (Credit2)

(Techniques in Bacterial Cytology and Virology)

Sr. No.	Name of the Practical (Bacterial Cytology and Cultivation)	practical
1.	Isolation, colony characters, Gram staining & motility of E.coli, Bacillus sp.	1
2.	Differentiation of fecal & non-fecal coli forms by IMViC Test	1
3.	Isolation, colony characters, Gram's staining and motility of Bacteria isolated from- Air (solid impaction technique)	1
4.	Study of Sugar (Glucose/Lactose) Fermentation ability of Microorganisms	1
Sr. No.	Name of the Practical (Virology)	practical
1)	Egg inoculation technique for virus cultivation by various routes-embryo, yolksac, allantoic fluid, amniotic cavity, chorioallantoic membrane	1
2)	Phage titration.	1
3)	Isolation of Coliphages from Sewage	1
4)	One step growth curve of Bacteriophage	1

References:

- 1. Experimental Microbiology - Patel*
- 2. Media Preparation - Dr. A.M. Deshmukh*
- 3. Bacteriological Techniques - F. J. Baker*

Practical code - DSC07BTEP3 (Credit 2)
(Techniques in Bioinstrumentation)

Sr. No.	Name of the Practical	Practicals
1)	Use, care and study of Compound Microscope	1
2)	Demonstration (Principle, working, construction) of Colorimeter	1
3)	Determination of λ - max of a dye solution (Any dye)	1
4)	Demonstration (Principle, working, construction) of PH meter	1
5)	Demonstration (Principle, working, construction) of Autoclave	1
6)	Demonstration (Principle, working, construction) of Centrifuge	1
7)	Demonstration (Principle, working, construction) of Hot air oven & Incubator	1
8)	Demonstration (Principle, working, construction) of Laminar Air Flow	1
9)	Separation of Small & Large Biomolecules by Dialysis technique	1

References:

- 1. Practical Biochemistry - J. Jayaraman*
- 2. Practical Biochemistry - David Plummer*

DSC07BTEP3 (Credit 2) (Techniques in Plant and Animal Sciences)

Sr. No.	Name of the Practical PLANT SCIENCES	Practicals
1)	Study of algae (<i>Nostoc, Sargassum</i>)	1
2)	Study of bryophyte (<i>Funaria</i>)	1
3)	Study of Pteridophyte (<i>Selaginella</i>)	1
4)	Study of gymnosperms (<i>Cycas</i>)	1
5)	Study of Angiosperms (Sunflower, Maize)	1
6)	Plant anatomy – Dicot and monocot root, stem, leaf	2
7)	Study of Dicot and Monocot Embryo.	1
8)	Study of different types of fruits.	1

References:

1. *Practical Handbook of Botany – by C.R.Patil and T.G.Nagraja*

Sr. No.	Name of the Practical ANIMAL SCIENCES	Practicals
1)	Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems	1
2)	Examination of histological sections from photomicrographs/ permanent slides of Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.	1
3)	Study of the different types of placenta- histological sections through permanent slides or photomicrographs,	1
4)	Study of placental development in humans by ultrasound scans.	1
5)	Study of Chick Embryo Development	1

References

1. *Practical Zoology by Lal.*

2. *Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV*

List of minimum equipment's-for Biotechnology-Entire

- 1) *Hot air oven - 1*
- 2) *Incubator - 1*
- 3) *Autoclave - 1*
- 4) *Refrigerator - 1*
- 5) *Students microscopes(oil immersion) - 10 nos. for one batch*
- 6) *Digital balance - 2*
- 7) *pH meter - 1*
- 8) *Centrifuge - 1*
- 9) *Colorimeter - 1*
- 10) *Distilled Water Plant - 1*
- 11) *Laminar air flow cabinet - 1*
- 12) *Colony counter - 1*
- 13) *Water bath - 1*
- 14) *Arrangements for gas supply and fitting of two burners per table.*
- 15) *One working table of 6' x 2½' for two students.*
- 16) *One separate sterilization room attach to the laboratory (10' x 15')*
- 17) *At least one wash basin for a group of five students*
- 18) *One separate instrument room attached to lab (10' x 15')*
- 19) *One laboratory for one batch including working tables (6' x 2½') per two students for one batch*
- 20) *Store room (10' x 15')*

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note: - At least 90% Practical's should be covered in practical examination.

