

Skill Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-1	Dairy Processing	240/BIOT/SE C101	1	-	4	1	-	2	3	5	20	15	35	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-2	Introduction to Cell Culture Techniques	240/BIOT/SE C201	1	-	4	1	-	2	3	5	20	15	35	75

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total

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SEC-3	Medical Laboratory Techniques	240 BIOT/SEC101	1	-	4	1	-	2	3	5	20	15	15	75
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Skill Enhancement Courses

Part A - Introduction			
Semester	I		
Name of the Course ID: 240/BIOT/SEC101	DAIRY PROCESSING		
Course Learning Outcomes (CLO):			
After completing this course, the learner will be able to:			
<ol style="list-style-type: none"> 1. The student will gain skills in dairy product development and hands-on training for the processing of different milk products. 2. The student can establish a startup based on their learnings in the subject. 3. The student can start provide 3rd party manufacturing to premiere dairy-based industries. 4. After completing this SEC, the student can work in any dairy based industry. 			
Credits	Theory	Practical	Total
	1	2	3
Contact Hours	1	4	5
Max. Marks:75 (20TE+ 05TI + 15 PI + 35PE)	Time: 2h (Theory), 4h (Practical)		
Part B- Contents of the Course			
Instructions for Paper-Setter			
Six questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus, will be compulsory. The remaining five questions will be set from entire syllabus. The candidates will be required to attempt Q.No.1 & any three others questions. All questions carry equal marks.			

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CONTACT HOURS

15

Operation Flood –Definition of Milk and Nutritive value of milk and ICMR recommendation of nutrients –Per Capita Milk production and availability in India and Haryana
State the need for processing milk.

- Different types of Milks & its Products.
- List the various units within a dairy processing plant
- List the machineries used in a dairy processing plant

Composition, Standards, Manufacturing - Process and Equipments for Manufacturing and Storage of Curd/Dahi, Yoghurt, Cheese and its types, Khoa, Panner, Ghee and Ice Cream

List of Practical:

1. Testing the quality of milk.
2. Processing of Flavoured milks.
3. Preparation of Dahi/Yoghurt.
4. Preparation of Ghee.
5. Preparation of Khoa/Panner.
6. Preparation of Ice cream.
7. Sensory evaluation of Milk based products.
8. Milk based new product development.
9. How to plan a startup, budgeting, marketing / case study/ entrepreneur (anyone of the above)?
10. Regulations, Licensing and registration of a start-up.
11. Visit to Dairy plant.

Suggested readings:

1. Dairy Science: Petersen (W.E.) Publisher – Lippincott & Company
2. Principles and practices of Dairy Farm -Jagdish Prasad
3. Text book of Animal Husbandry - G C Benarjee
4. Hand book of Animal Husbandry - ICAR Edition
5. Outlines of Dairy Technology – Sukumar (De) – Oxford University press

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6. Indian Dairy Products – Rangappa (K.S.) & Acharya (KT) - Asia Publishing House.
7. The technology of milk Processing – Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N. – Shri Lakshmi Publications.
8. Dairy India 2007, Sixth edititon.
9. Economics of Milk Production – BharatiPratima Acharya Publishers.
10. <http://www.asci-india.com/BooksPDF/Dairy%20Farmer%20or%20Entrepreneur.pdf>
11. <https://labour.gov.in/industrial-safety-health>

Semester	II		
Name of the Course: 240/BIOT/SEC201	Introduction to CELL CULTURE TECHNIQUES		
Course Learning Outcomes (CLO):			
1. Students will gain significant experience in handling the cells (microbial, animal & plant) through culture. Through integrated learning methods, utilizing hands-on training to reinforce lecture material participants will learn the biological basis and relevance of the process of culturing cells.			
2. The course will provide in detail knowledge of basic instruments involved in culture laboratory, so that the students can easily be acquainted as operators in several cell culture & diagnostic laboratory.			
3. In-hand experiments based on cell culture, development of slides, staining and anaiysis, along with documentation will impart experiential knowledge to students. The students in future can easily find way in cell culture & diagnostic laboratory.			
4. Students will learn basics of plant propagation, learning massive propagation of plants now-a-days is very popular for profitable enterprise.			
Credits	Theory	Practical	Total
	1	2	3
Contact Hours	1	4	5
Max. Marks:75 (20TE+ 5TI + 15 PI + 35PE)	Time: 2h (Theory), 4h (Practical)		

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Part B- Contents of the Course

Instructions for Paper-Setter

Total six questions will be set. Question 1 comprising objective/ short answer type will be compulsory. The remaining five questions will be set from the entire syllabus. Students have to attempt total four questions including Q1 (compulsory) and three questions out of remaining five questions. All questions carry equal marks.

Introduction & biology of cultured cells; Equipment, aseptic techniques, safety protocols, Properties and uses of chemicals commonly used in cell culture laboratories. Culture vessels & media development (for animal cell culture); solid versus suspension culture. Different phases of cell growth (cell cycle concept and factors affecting cell growth in culture). Applications of cell culture


Animal Cell Culture: Definition, cell lines, finite & continuous cell lines, culture conditions, Concept of Primary culture & secondary culture, preparation of primary culture (disaggregation of animal tissues via mechanical, enzymatic and EDTA).

Plant Cell Culture: Overview of plant cell culture, plant cell growth in culture, isolation and culture of single cell, Callus culture and suspension culture, Protoplast culture, Storage and revival of cells.

CONTACT HOURS
15

List of Practicals

1. Principle, working & precautions of several basic equipment of biotechnology lab (weighing balance, autoclave, laminar air flow, incubator, spectrophotometer, centrifuge, microscope).
2. Preparation of animal cell culture media.
3. Preparation of plant cell culture media.
4. Handling of cells *in-vitro*: Determination of cell growth, cell count and viability.
5. Preparation of primary cell culture using enzymatic approach in tissue disaggregation.
6. Preparation of primary cell culture using mechanical approach in tissue disaggregation
7. To subculture a confluent primary culture in maintaining animal cell culture.
8. Isolation of single cell isolation for plant cell culture.

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9. Culture of single cell isolation for plant cell culture.
10. To determine cell viability in plant cell culture.
11. To demonstrate protoplast isolation.
12. Visit to Animal and Plant Cell Culture Laboratories in University or Institute.

Part C-Learning Resources

- a) Culture of Animal Cells by R. Ian Freshney.
- b) Animal Cell Culture: Principles and Practice by Shalini Mani, Manisha Singh, Anil Kumar
- c) Experiments In Microbiology, Plant Pathology and Biotechnology - K. R. Aneja
- d) Plant cell culture protocols. - Victor M. Loyola-Vargas and Felipe Vázquez-Flota (2nd edition).
- e) <https://microbenotes.com/animal-cell-culture/>
- f) https://www.sigmaaldrich.com/IN/en/technical-documents/technical-article/cell-culture-and-cell-culture-analysis/primary-cell-culture/primary-cell-culture?si:slid=AfmBOoqYZO_8NnANb6nJ00tSLuvaXD4MGqZlujPOKGW-jlrQhllizWXo

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Minor Course from the department of Zoology

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-1	Introduction to Non-Chordates	250/200/17 104	1	-	2	1	-	1	2	5	20	5	20	50

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-2	Introduction to Chordates	250/200/17 201	1	-	2	1	-	1	2	5	20	5	20	50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total

M. Saini
(Dr. Manish Saini)

MIC-3	Introductory Human Physiology		2	-	4	2	-	2	4	15	35	15	35	100
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Semester 6

Course Code	Course Title	Course ID	L T P P				Credits				MARKS			
			L	T	P	P	(Hrs)	Credits	Credits	Credits	TI	TE	PI	PE
MIC-4	Basics of Forensic Biology		2	-	4	2	-	2	4	15	35	15	35	100

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ZOOLOGY: SEMESTER-I

Course Type	Course Code	Name of the Course	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
MIC-1 2 credits		Introduction to Non-Chordates	1	1	5	20	25	2 hrs.
		Practical	1	2	5	20	25	2 hrs.

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

- Student will be able to understand about phylum Protozoa and Porifera
- Student will be able to understand about phylum Coelenterata and Helminthes
- Student will be able to understand about phylum Annelida and Arthropoda
- Student will be able to understand about phylum Mollusca, Echinodermata and Hemichordates
- Students will be capable of identifying the characters and classification of Non-Chordates up to class level

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Phylum Protozoa: General characters and classification of Protozoa up to class level with their ecological and economic importance Phylum Porifera: General characters and classification of Porifera up to class level with their ecological and economic importance	4
II	Phylum – Coelenterata: General characters and classification of Coelenterates up to class level with their ecological and economic importance Helminths: General characters and classification of Helminthes up to class level with their ecological and economic importance	4

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III	Phylum – Annelida: General characters and classification of Annelids up to class level with their ecological and economic importance Phylum – Arthropoda: General characters and classification of Arthropods up to class level with their ecological and economic importance	4
IV	Phylum - Mollusca: General characters and classification of Mollusca up to class level with their ecological and economic importance Phylum – Echinodermata: General characters and classification of Echinoderms up to class level with their ecological and economic importance Phylum Hemichordata: General Characters of Hemichordates with examples	3
V Practical	Classification up to orders with ecological note and economic importance of the following animals: Protozoa: Permanent slides: <i>Amoeba</i> , <i>Euglena</i> , <i>Paramecium</i> (binary fission and conjugation), <i>Opalina</i> Porifera: <i>Sycon</i> , <i>Grantia</i> , <i>Euplectella</i> , <i>Hyalonema</i> , Coelenterata: <i>Physalia</i> , <i>Aurelia</i> , <i>Metridium</i> , <i>Millipora</i> , <i>Favia</i> , <i>Fungia</i> , Permanent slides of <i>Hydra</i> (W.M.), <i>Hydra</i> with buds, <i>Obelia</i> (colony and medusa), <i>Aurelia</i> . Playhelminthes: <i>Fasciola</i> , <i>Taenia</i> , Aschelminthes: <i>Ascaris</i> (male and female), <i>Ancylostoma</i> , Annelida: <i>Pheretima</i> , <i>Heteronereis</i> , <i>Polynoe</i> , <i>Chaetopterus</i> , <i>Tubifex</i> and <i>Pontobdella</i> Arthropoda: <i>Palaemon</i> (Prawn), <i>Cancer</i> (Crab), <i>Periplaneta</i> (cockroach), <i>Poeciloceris</i> (ak- hopper), <i>Mantis</i> (praying mantis), Dragon fly, termite queen, bug, moth, <i>Polistes</i> (wasp), <i>Apis</i> (Honey bee), <i>Bombyx</i> (Silk moth) Mollusca: <i>Mytilus</i> , <i>Ostrea</i> , <i>Solen</i> (razor Fish), <i>Pecten</i> , <i>Octopus</i> , <i>Chiton</i> and <i>Dentalium</i> Echinodermata: <i>Asterias</i> , <i>Echinus</i> , <i>Cucumaia</i> , <i>Antedon</i>	30
Learning Resources		
Jordan, E.L and P.S. Verma. 2009. Invertebrate Zoology, S.Chand and Co. Ltd. New Delhi.		
Ayyar, E.K and T. Ananthakrishnan. 1992. Manual of Zoology Vol.1 Invertebrates Part I and II, S.Viswanathan Printers and Publishers Pvt. Ltd. Madras.		
Kotpal, R.L. 2021. Zoology Invertebrates. Rastogi Publications, Meerut.		
Nair, N.C., N. Arumugam, N. Soundarapandian, T. Murugan and S. Leelavathy. 2010. A textbook of Invertebrates. Saras Publication, Nagercoil.		
Rastogi V.B. 2021 . Invertebrate Zoology. Kedar Nath Ram Nath , Meerut		
Lal S.S. 2019. Practical Zoology Invertebrates. Rastogi Publications, Meerut		
Anderson D.T. (1999) Invertebrate Zoology, Oxford University Press		
Edward E. Ruppert, Robert D. Barnes (1994)· Invertebrate Zoology ; Saunders College Pub.		

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ZOOLOGY: SEMESTER-2

Course Type	Course Code	Name of the Course	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
MIC-2 2 credits		Introduction to Chordates	1	1	5	20	25	2 hrs.
		Practical	1	2	5	20	25	2 hrs.

Level of the course: 100-199

Pre-requisite for the course (if any): NA

Course Learning Outcomes (CLO)

- Student will be able to describe unique characters of Protochordates
- Student will be able to describe unique characters of Pisces
- Student will be able to describe unique characters of Amphibians & Reptiles
- Student will be able to describe unique characters of Birds & Mammals
- Students will be capable of identifying the characters and classification of Chordates

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.

Question No. 1, which will be short answer type covering the entire syllabus will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Chordates: Salient features of chordates; Principles of classification; Origin and evolutionary tree of chordates Protochordates: Urochordata & Cephalochordates: Systematic position, distribution, ecology, morphology and affinities	4
II	Cyclostomata: General characters and classification up to class level. Ecological significance of cyclostomes Pisces: General characters and classification up to classes with examples emphasizing their biodiversity, Scales & Fins,	4
III	Amphibia: General Characters and Classification up to class level; Parental Care and Neoteny in Amphibia Reptilia: General Characters and Classification up to classes, Extinct reptiles; Poisonous apparatus in	4

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	snakes			
IV	<p>Aves: General Characters and classifications up to class level. Flight/Aerial adaptation in birds</p> <p>Mammals: General Characters and classification up to class level. Adaptive radiations of mammals, dentition in mammals.</p>	3		
V Practical	<p>I. Classification upto orders, habit, habitats, external characters and economic importance (if any):</p> <ul style="list-style-type: none"> • Protochordata: <i>Molgula</i>, <i>Pyrosoma</i>, <i>Doliolum</i>, <i>Olikopleura</i>, and <i>Amphioxus</i>. • Cyclostomata: <i>Petromyzon</i> and <i>Ammocoetus</i> larva. • Chondrichthyes: <i>Zygaena</i>, <i>Pristis</i>, <i>Narcine</i> (electric ray), <i>Trygon</i>, <i>Rhinobatus</i> and <i>Chimaera</i>. • Osteichthyes: <i>Acipenser</i>, <i>Muraena</i>, <i>Mystus</i>, <i>Catla</i>, <i>Hippocampus</i>, <i>Syngnathus</i>, <i>Exocoetus</i>, <i>Anabas</i>, <i>Diodon</i>, <i>Tetradon</i>, <i>Echinus</i>, <i>Solea</i> and <i>Polypterus</i>. Any of the Lung Fishes. • Amphibia: <i>Necturus</i>, <i>Proteus</i>, <i>Amphiuma</i>, <i>Salamandra</i>, <i>Amblystoma</i>, <i>Axolotl</i> larva, <i>Alytes</i>, <i>Bufo</i>, <i>Rana</i>. • Reptilia: <i>Hemidactylus</i>, <i>Calotes</i>, <i>Draco</i>, <i>Varanus</i>, <i>Phrynosoma</i>, <i>Chamaeleon</i>, <i>Python</i>, <i>Ptyas</i>, <i>Bungarus</i>, <i>Naja</i>, <i>Hydrus</i>, <i>Viper</i>, <i>Crocodilus</i>, <i>Gavialis</i>, <i>Chelone</i> (Turtle) and <i>Testudo</i> (Tortoise). • Aves: <i>Casuarus</i>, <i>Arden</i>, <i>Anas</i>, <i>Milvius</i>, <i>Pavo</i>, <i>Eudynamis</i>, <i>Tyto</i>, <i>Alcedo</i>, <i>Halcyon</i> • Mammalia: <i>Ornithorhynchus</i>, <i>Echidna</i>, <i>Didelphis</i>, <i>Macropus</i>, <i>Loris</i>, <i>Macaque</i>, <i>Hystrix</i>, <i>Funambulus</i>, <i>Felix</i>, <i>Panthera</i>, <i>Canis</i>, <i>Herpestes</i>, <i>Capra</i>, <i>Pteropus</i>. <p>2. Study of the skeleton of <i>Oryctolagus</i>/rat</p> <p>3. Study of the following prepared slides: T.S. <i>Amphioxus</i> (through different regions). Histology of rat (compound tissues), different types of scales.</p>	30		
	<p style="text-align: center;">Learning Resources</p> <ol style="list-style-type: none"> 1. R.L. Koipal. Modern Textbook of Zoology 2. E.L. Jordan and Verma. Chordate Zoology. 3. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh. 4. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York. 5. Kent, C.G. Comparative anatomy of vertebrates. 6. S.S. Lal. Practical Zoology Vertebrate 			

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ZOOLOGY: SEMESTER-3

Course Type Code	Name of the Course	Credit	Contact Hours/ Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
MIC-3 4 credits	Introductory Human Physiology Practical	2	2	15	35	50	2 hrs.
Level of the course: 100-199		2	4	15	35	50	2 hrs.

Pre-requisite for the course (if any): **Biology as a Subject at 4.0 Level (Class XII)**
Course Learning Outcomes (CLO)

Students will gain knowledge about the basic principles of physiology of both cells and organisms.
 Students will acquire appropriate understanding of functioning of each system of human body and their regulation
 Students will be able to perform some basic qualitative analytical test of some biomolecules

Instructions for Paper-Setter

Nine questions will be set in all. All questions will carry equal marks.
 Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Physiology of Digestion: Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids. Physiology of Respiration: Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood, oxygen dissociation curve of hemoglobin, Bohr's effect, Hamburger's phenomenon (Chloride shift) Physiology of Circulation: Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle, electrocardiogram, cardiac output, Composition and functions of blood Excretion: ornithine cycle (Kreb's-Henseleit cycle) for urea formation in liver. Urine formation, counter-current mechanism of urine concentration, osmoregulation Neural Integration: Structure of neuron, Nature, origin and propagation of nerve impulse along with medullated & non-medullated nerve fibre, conduction of nerve impulse across synapse.	8
II		8
III		7

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IV	<p>Chemical integration of Endocrinology: physiology of hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads.</p> <p>Physiology of reproduction: Spermatogenesis, oogenesis, Fertilization, Menstrual cycle, Hormonal regulation of spermatogenesis and oogenesis</p>	7
V Practical	<p>Perform qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose and Starch)</p> <p>Knowledge of daily requirement and deficiency disorders of macronutrients (Carbohydrates, Fats and proteins) and micronutrients like Iron, Zinc, Calcium, Magnesium etc. in the diet of children, young adults, pregnant/lactating and elderly.</p> <p>Study of activity of salivary amylase under optimum conditions, effect of temperature, pH on activity of Salivary amylase</p> <p>Preparation of Hematin crystals from dry or fresh blood</p> <p>DLC from your own blood</p> <p>Hb estimation from your own blood</p> <p>Study the Use of respirometer/Kymograph</p>	60
Learning Resources		
<ol style="list-style-type: none"> 1. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc. 2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 3. Chatterjee C C , Human Physiology. 1992. 4. Guyton, Text book of Medical Physiology, 10th Ed. W B Saunders 23 5. Wood, D.W. Principles and Animal physiology, 1968. 		

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ZOOLOGY: SEMESTER-6

Course Type	Course Code	Name of the Course	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
MIC-4 4 credits		Basics of Forensic Biology	2	2	15	35	50	2 hrs.
		Practical	2	4	15	35	50	2 hrs.
Level of the course: 100-199								
Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)								
Course Learning Outcomes (CLO)								
1. Students will be able to understand basics of forensic biology, scope of forensic biology in national and international field								
2. Students will learn crime scene investigation, collection of various samples and evidences and analysis								
3. Students will learn various methods used in forensic studies and analysis, and perform some basic methods.								
1. Students will learn about legal aspects, different national agencies and institutions, legal aids								
Instructions for Paper-Setter								
1. Nine questions will be set in all. All questions will carry equal marks.								
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.								
UNIT	TOPICS							
I	Scope of forensics: Definition, history, international and national fields, evidences and their classification- specific socio-economic offences against human body, property, terrorism, pollution, adulteration- description of sham crime scene, establishment of identity and importance of motivation.							
II	Finger printing: History, fundamental and principles, Henry system, primary classification and computerized prints; Types of injuries/wounds; signs and symptoms of death time; time of death and post mortem changes; Blood stains; grouping and identification; disputed paternity and DNA tests; Physical evidences-Identification, comparison; collection methods and preservation of hair, fibre, paint, glass and soil- Fire arms, tool marks and impressions							
III	Forensic medicine: Insects of forensic importance, Biology of insects of forensic importance, venoms and poisons, methods employed for forensic analysis, Medico legal issues of organ transplantation, organ racketing, euthanasia, sexual offences, rape, semen analysis.							
	CONTACT HOURS							
	8							
	8							
	7							

	<p>Food poisons & narcoanalysis: Classification and sources of drugs, narcotics, cosmetics and abortifacients, physiological and psychological effects, toxic nature of poisoning, sources of poisons and Toxicity testing, methods and instruments for toxicity analysis, Narco-analysis.</p> <p>Information technology and legal aspects: cyber-crime, law of robotics, laws and data mining, super imposing techniques, e-com and intelligent systems, justice and law- sources, enactments, judiciary, legal aid, laws of copyrights and patents. Forensic sourcing: Enforcement agencies, public and private: police, CBI- National Institute of criminology and forensic science, Interpol, Prisons and rehabilitation</p>	7
IV	<ol style="list-style-type: none"> 1. Principle and procedure for DNA extraction from fresh/clotted blood. 2. Principle and procedure for DNA extraction from hair, tissue and buccal swap. 3. Principle and procedure for Blood grouping from dried strains / dots. 4. Principle and procedure for Paternity testing using PCR methods 5. Pedigree Analysis-chart method. 6. Principle and procedure for Semen analysis (cattle sample from veterinary department). 7. Principle and procedure for Fingerprinting analysis 	60
V Practical	<p style="text-align: center;">Learning Resources</p> <ol style="list-style-type: none"> 1. Forensic Medicine (1979), Simpson, K, ELBS (8th edition) 2. Criminalistics, an introduction to forensic sciences: (1978). Safertein, R. Frenitice Hall of India, New Delhi. 3. An introduction to Forensic DNA Analysis (2002). Rudin, N and Crim, K.I.C CRC Press, New York. 	

(Scheme UG 04: (Interdisciplinary))

Semester 1

Course Code	Course Title	Course ID	L T P			Credits			MARKS							
			(Hrs)						TI	TE	PI	PE	Total			
Core Course(s)																
CC-ID1	Fundamentals of Genetics	240/BIOT/CC101	3	-	2	3	-	1	4	25	50	5	20	100		
CC-ID2	Basic Cell Biology	240/BIOT/CC102	3	-	2	3	-	1	4	25	50	5	20	100		
CC-ID3	Basis of Biomolecules	240/BIOT/CC103	3	-	2	3	-	1	4	25	50	5	20	100		

Semester 2

Course Code	Course Title	Course ID	L T P			Credits			MARKS							
			(Hrs)						TI	TE	PI	PE	Total			
Core Course(s)																
CC-ID4	General Microbiology	240/BIOT/CC 201	3	-	2	3	-	1	4	25	50	5	20	100		
CC-ID5	Cellular Metabolism	240/BIOT/CC 202	3	-	2	3	-	1	4	25	50	5	20	100		
CC-ID6	Basis of Molecular Biology	240/BIOT/CC 203	3	-	2	3	-	1	4	25	50	5	20	100		

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Semester 3

Course Code	Course Title	Course ID	L T P			Credits	Total Credits	MARKS				
			L (Hrs)	T	P			TI	TE	PI	PE	Total
Core Course(s)												
CC-ID7	Bioanalytical Tools	240/BIOT/CC3 01	3	-	2	3	4	25	50	5	20	100
CC-ID8	Fundamentals of Immunology	240/BIOT/CC3 02	3	-	2	3	4	25	50	5	20	100
CC-ID9	Basic Enzymology	240/BIOT/CC3 03	2	-	2	2	3	15	35	5	20	75

Semester 4

Course Code	Course Title	Course ID	L T P			Credits	Total Credits	MARKS				
			L (Hrs)	T	P			TI	TE	PI	PE	Total
Core Course(s)												
CC-ID10	Basics of Recombinant DNA Technology	240/BIOT/CC4 01	3	-	2	3	4	25	50	5	20	100
CC-ID11	Introduction to Medical Microbiology	240/BIOT/CC4 02	3	-	2	3	4	25	50	5	20	100

CC-ID12	Introduction to Animal Biotechnology	240 BIOT/CC 03	3	-	2	0	1	4	25	50	5	20	100
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Internship is to be done during summer break after 4th semester, Marks will be added in 5th Semester

Semester 5

Course Code	Course Title	Course ID	L T P			Credits	Total Credits	MARKS				
			(Hrs)					TI	TE	PI	PE	Total
Core Course(s)												
CC-ID13	Introduction to Bioinformatics	240/BIOT/CCS 01	3	-	2	3	4	25	50	5	20	100
CC-ID14	Fundamentals of Genomics and Proteomics	240/BIOT/CCS 02	3	-	2	3	4	25	50	5	20	100
CC-ID15	Introduction of Forensic Biotechnology	240/BIOT/CCS 03	2	-	4	2	4	15	35	15	35	100

Semester 6

Course Code	Course Title	Course ID	L T P			Credits	Total Credits	MARKS				
			(Hrs)					TI	TE	PI	PE	Total
Core Course(s)												

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CC-ID16	Introduction to Plant Biotechnology	240/BIOT/CC601	3	-	2	3	-	1	4	25	50	5	20	100
CC-ID17	Bioprocess Technology	240/BIOT/CC602	2	-	4	2	-	2	4	15	35	15	35	100
CC-ID18	Bioethics, IPR & Entrepreneurship	240/BIOT/CC603	2	-	2	2	-	1	3	15	35	5	20	75

Semester 7: 8 (Honours) and Semester 8 (Honours with Research): Detailed Scheme will be prepared in due course of time.

UG PROGRAMME (INTERDISCIPLINARY)

B.Sc Biotechnology 1st Sem

Semester	Part A - Introduction
	I
Name of the Course ID1 : 240/BIOT/CC101	Fundamentals of GENETICS
Course Learning Outcomes (CLO):	
After completing this course, the learner will be able to:	
1. Appreciate the historical developments that have shaped the field of genetics.	
2. Understand the principles of inheritance as formulated by Mendel and the correlation of these principles with the behavior of chromosomes during meiosis.	
3. Develop a critical understanding of allelic and non-allelic interactions, sex-linked transmission, polygenic and extranuclear inheritance.	

4. Understand the organization of prokaryotic and eukaryotic genomes and the effect of chromosomal abnormalities leading to genetic disorders.
5. Apply the concepts of genetic linkage and crossing for calculating gene distances and generating genetic maps.
6. Apply the Hardy-Weinberg Law in the context of population genetics.
7. Develop analytical skills and critical thinking through pedigree analysis and solving numerical based on theoretical concepts.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100	Time: 2h (Theory), 2h (Practical)		
Internal Assessment Marks: 30 (25 Theory + 05 Practical)			
End Term Exam Marks: 70 (50 Theory + 20 Practical)			

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT I

Genetics - Definition, history, and terminology

Mendelian genetics: Mendel's work on transmission of traits, Principles of Inheritance, monohybrid, di-hybrid, and trihybrid crosses, test cross, backcross. Chromosome theory of inheritance (Sutton-Boveri) and its relation to cell division

Extensions of Mendel's Principles: Allelic interactions: Incomplete and codominance; multiple alleles, pseudo alleles, essential and lethal genes, pleiotropy, penetrance, and expressivity. Non-allelic

CONTACT HOURS

14

(-) ~~Probability~~

Alpha
Delta
Gamma

<p>interactions: Complementary gene interaction; Dominant and Recessive Epistasis; Duplicate gene interactions; Inhibitory gene interactions.</p> <p>Polygenic traits- quantitative inheritance (human skin colour)</p>	<p style="text-align: center;"><u>UNIT II</u></p> <p style="text-align: center;">10</p> <p style="text-align: center;">Linkage, Crossing Over, and Chromosomal Mapping</p> <p>Linkage: Chromosome theory of linkage, types of linkage, linkage groups, factors affecting linkage and significance of linkage Crossing Over: Types of crossing over, Molecular mechanism of crossing over; cytological basis of crossing over, factors affecting and significance of Crossing over Chromosomal Mapping: Recombination frequency as a measure of linkage intensity, two-factor and three-factor crosses, determination of map distance, determination of gene order, Interference and coincidence.</p> <p>Sex determination and sex linkage: Mechanisms of sex determination, genic balance theory, Environmental factors and sex determination, Barr bodies, dosage compensation, inheritance of Sex-linked, Sex-influenced, and Sex-limited characters</p>	<p style="text-align: center;"><u>UNIT III</u></p> <p style="text-align: center;">14</p> <p>Chromosome and genomic organization: Organization of prokaryotic, viral, and eukaryotic nuclear genome, packaging of DNA molecule into chromosomes, chromosome morphology, chromosome types, concept of euchromatin and heterochromatin (constitutive and facultative). Special types of chromosomes- Polytene chromosomes and Lampbrush Chromosomes. Chromosome banding pattern and Karyotype.</p> <p>Chromosomal aberrations: Structural aberrations (Deletions, Duplications, Inversions & Translocations-reciprocal and Robertsonian) Position effects of gene expression, Numerical aberrations (Euploidy and Aneuploidy).</p> <p style="text-align: center;"><u>UNIT IV</u></p>
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~~Explain~~

~~Sex differentiation~~

~~(5) Mutations~~

Redigal analysis

<p>Extrachromosomal Inheritance Characteristics of extranuclear inheritance, Chloroplast mutation/Variation in Four o'clock plant and <i>Chlamydomonas</i>, Mitochondrial mutations in <i>Neurospora</i> and yeast, Maternal effects- snail shell coiling, Infective heredity- Kappa particles in <i>Paramecium</i>, Genomic imprinting</p> <p>Population Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law and its application for calculating allelic and genotype frequencies, exceptions to the Hardy-Weinberg principle.</p>	<p>List of Practical:</p> <ol style="list-style-type: none"> 1. Study of Mendelian Traits: Straight hair (recessive), Curly hair, Widow's peak, Dimpled cheeks, Tongue rolling and folding, Mid digital hair, Hitchhiker's thumb, Clasp of hands, Cleft chin and Attached ear lobe 2. Simple genetic problems based on monohybrid cross, dihybrid cross, trihybrid cross, incomplete dominance, co-dominance and gene interactions. 3. Use of probability in solving problems of genetics. (Sum rule & Multiplication rule) 4. Simulation exercises using beads or seeds to study the gene interactions: 9:3:4; 12:3:1; 9:7; 9:3:3:1 (comb shapes in roosters); 15:1; 13:3. 5. Linkage maps based on data from two-point and three-point test cross. 6. Preparation of buccal epithelial smear and observation of Barr body. 7. Study of polyploidy in onion root tip by colchicine treatment. 8. PTC testing in a population and calculation of allele and genotype frequencies. 9. Study of pedigree charts of Autosomal Dominant trait, Autosomal recessive trait, X-linked Dominant traits, X-linked recessive traits and Y-linked traits). 10. Study of abnormal karyotypes with the help of photographs
7	
<p>Part C-Learning Resources</p> <ol style="list-style-type: none"> 1. D.P. Snustad, and M.J. Simmons, Genetics, 7th Ed., John Wiley & Sons. (Singapore) 2015 ISBN: 978-1-119-14228-7. 2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics, X Edition. 	

Practical

Redigal analysis

3. B.A Pierce, Genetics - A Conceptual Approach, 4th Ed., W.H. Freeman & Co. (New York) 2012 ISBN: 978-1-4292-7606-1

4. A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis, 10th Ed., W.H. Freeman & Company (New York), 2010 ISBN: 10: 1-4292-2943-8 2.

5. Peter, J. Russell, (2009), iGenetics: A molecular approach, 3rd Edition.

6. P.K. Gupta, Elements of Genetics, Rastogi Publications

7. Verma P.S. & Agarwal V.K (2009) Genetics, S. Chand Publications

8. B. D. Singh FUNDAMENTALS OF GENETICS (13th Edition)- Meditech Science Press

Part A - Introduction			
Semester	I		
Name of the Course ID2 : 240/BIOT/CCI02	Basics of CELL BIOLOGY		
Course Learning Outcomes (CLO):	After completing the course, the learner will be able to :		
	1. Understand the structures and functions of basic components of plant and animal cell, especially macromolecules, membranes and organelles		
	2. acquire knowledge about the organizational and functional aspects of cell and cell organelles		
	3. cultivate knowledge regarding basics of components of cell wall cell membrane and its role in transport.		
	4. Understand the basic principles of life, how a cell divides and how it is so highly regulated		
	5. Acquire knowledge regarding cell death and what happens when a cell do not follow the rules of cell cycle.		
	6. Understand the concept of cell signalling, cell interactions and structures involved in these.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100	Time: 2h (Theory), 2h (Practical)		

(50 TE + 25 TI + 05 PI +
20 PE)

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No. I comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No. I & four others selecting one question from each unit. All questions carry equal marks.

	CONTACT HOURS
UNIT I a) Historical perspectives. Discovery of cell, the cell theory, ultra structure of a prokaryotic cell & eukaryotic cell- (both plant and animal cells) b) Structure and function of cell wall - Bacterial and Plant. Ultra structure of plasma membrane - fluid mosaic model, membrane fluidity. Transport across membranes - Symport, antiport, uniport, active and passive transport. Transport of macromolecules across plasma membrane. c) Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes.	12
UNIT II a) Structure & Functions of cell organelles: Endoplasmic Reticulum (SER & RER), golgi apparatus, Lysosomes, b) Microbodies (peroxisomes and glyoxysomes), Ribosomes and its types, centrioles, basal bodies. c) Structure, functions & biogenesis of mitochondria, chloroplast. d) Cytoskeletal structures: microtubules, microfilaments (actin, myosin), Intermediate filament	12
UNIT III a. Structure and organization of nucleus: nuclear membrane, organization of chromosomes- structural organization of chromatids, centromere, chromatid, telomere b. Cell division: Cell cycle, mitosis and meiosis, regulations of cell cycle and check points and proteins involved in cell cycle check points.	11

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<p>UNIT IV</p>	<p>a) Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix. b) Programmed cell death, Apoptosis c) Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics of cancer cells, (Oncogenes, tumour suppressor gene.</p>	<p>10</p>
<p>List of Practical:</p> <ol style="list-style-type: none"> 1. Operation and working principle of simple and compound microscope. 2. To study plant cell by temporary mount. 3. Observation of permanent slides (Prokaryotic, animal & plant cell) 4. Use of Micrometry, measurement of onion epidermal cells and yeast. 5. Vital staining of mitochondria with Janus Green B in buccal epithelium or plant epidermal cells. 6. Study the effect of temperature & organic solvent on semi permeable membrane. 7. Demonstration of Technique of dialysis. 8. Study of plasmolysis and deplasmolysis in cells 9. Study of different mitotic stages in onion root tip cells 10. Study of meiosis in plant flower buds 		
<p>Part C-Learning Resources</p> <ol style="list-style-type: none"> a) Geoffrey M. Cooper, Robert E. Hausman, 2007. The Cell-A molecular approach (Fourth Edition)- ASM Press Washington D.C. b) Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons Inc. c) Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Bernell, 2009. Molecular Cell Biology (Fourth edition). Media Connected – W.H.Freeman and Company. d) P.S. Verma and V.K. Agarwal, 2012. Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi. e) Ambrose, and Dorothy, M., Easty 1971. Cell biology, ELBS Publications f) Bruce Alberts, Alexander Johnson, Julian Lewis, et al., 2014 Molecular Biology of Cell – Garland publications g) Gardner, E.J., Simmons M.J., and Spustad D.P., 1991. Principles of Genetics –John Wiley and Son Publications. 		

Part A - Introduction			
Semester	I		
Name of the Course ID3 : 240/BIOT/CC103	BASICS OF BIOMOLECULES		
Course Learning Outcomes (CLO):	<ol style="list-style-type: none"> After successful completion of the programme, students will gain significant knowledge of structural biochemistry and how these small biomolecules attribute in constructing higher living organism. Students will learn the structure and properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, complex lipids, and their importance in biological systems Students will acquire an in-dept knowledge of nucleic acid (structural and properties) which will help in understanding the basis molecular processes of living beings. The students will know the distribution, arrangement, and properties of biomolecules in dietary products, which will impart awareness in adapting healthy lifestyle and student can be acquainted in assisting dietician and nutritionist. Students will know how to test the presence of biomolecules in our surrounding and how to differentiate between carbohydrates/ proteins/ lipids and nucleic acid. This will help in assessing the nutrition value of the food consumed. The students will be able to implement the use of instruments like and UV-VIS spectroscopy, centrifugation, and chromatography. 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 100 (50TE+ 25TI + 05 PI + 20PE)	Time: 2h (Theory), 2h (Practical)		

Part B- Contents of the Course

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Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus. will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT	Amino acids & Proteins: Structure & Function	CONTACT HOURS
a)	Amino Acid: Structure, specific rotation, electrochemical properties, classification based on R-group, nutritional requirement, and metabolic fate	12
b)	Representation of peptide bond; Chemical bonds involved in protein structure	
c)	Protein configuration: Primary structure, Secondary structure (α -helix and β -pleated sheet), Tertiary structure (myoglobin) and Quaternary structure (Hemoglobin)	
d)	Classification of Proteins: Based on shape, composition, biological function. Denaturation and renaturation of proteins	
UNIT II	Carbohydrates: Structure and Function	12
a)	Nomenclature and Definition: Classification: Monosaccharides, Oligosaccharides and Polysaccharides	
b)	Monosaccharides: Isomerism; Mutarotation; Structure-Linear form and Ring form, pyranose and furanose structure; anomers; epimers	
c)	Oligosaccharides: reducing and non-reducing sugar; disaccharides (sucrose, lactose, maltose, cellobiose, isomaltose, trehalose); artificial sweeteners	
d)	Polysaccharides: Homopolysaccharides (Starch, Glycogen, Cellulose, Pectin & Chitin), Heteropolysaccharides (Hyaluronic acid & Chondroitin)	
UNIT III	Lipids: Structure and functions	11
a)	Importance and definition of lipids; basic structural components: Fatty Acid-saturated and unsaturated fatty acids (nomenclature & structure); Biological roles of lipids	
b)	Simple lipids (Fats & Oils), Compound (Phospholipids & Glycolipids)	
c)	Derived Lipids (Steroids: cholesterol - its structure and biological properties; Terpenes; Carotenoids)	
UNIT IV	Nucleic acids: Structure and functions	10
a)	Introduction; Types of nucleic acids; Structural components of nucleic acids	

<p>b) Nitrogenous bases: Structure of Pyrimidino & Purine derivatives; modified nitrogenous bases; tautomerism in nitrogenous bases; Nucleosides: nomenclature & structure</p> <p>c) Nucleotides: nomenclature & structure (ribonucleotides & deoxyribonucleotides); functions of nucleotides</p> <p>d) Double helical model of DNA structure, Chargaff's Rule, Variants of double helical DNA (A, B, C and Z-DNA), denaturation and annealing of DNA.</p>	<p>List of Practicals</p> <ol style="list-style-type: none"> 1. Preparation of solution with specific concentration and pH. 2. Preparation of stock and working solution. 3. To perform qualitative tests to find the presence of carbohydrates in a sample. 4. To perform tests to differentiate between monosaccharide, disaccharide, and polysaccharide. 5. To perform tests to identify reducing and non-reducing sugars. 6. To perform qualitative tests to find the presence of proteins in a sample <ol style="list-style-type: none"> a) Biuret test b) Ninhydrin test c) Lowry's test 7. To perform paper chromatography test to separate mixture of amino acids. 8. To perform qualitative & quantitative determination of nucleic acids. 9. To perform tests to find the presence of lipids in a sample. 	<p>Part C-Learning Resources</p> <ol style="list-style-type: none"> 1. Fundamentals of Biochemistry by J.L. Jain (S. Chand & Company Ltd.) 2. The Foundations of Biochemistry by Lehninger 3. Biochemistry - J.M. Berg, J. L. Tymoczko, L. Stryer, 5th ed 4. Biochemistry-Reginald H. Garret, Charles M. Grisham 6th ed 5. Berg, J.M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. WH Freeman and Co. 6. Essentials Of Biochemistry, U. Satyanarayana, U. Chakrapani, (2021), Publisher-Elsevier
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Dr. P. K. S. Reddy

SEMESTER-II

INTERDISCIPLINARY - BIOTECHNOLOGY

Semester	II									
Name of the Course ID4: 240/BIOT/CC201	GENERAL MICROBIOLOGY									
Part A - Introduction										
<p>Course Learning Outcomes (CLO): After completing this course, the learner will be able to:</p> <ul style="list-style-type: none"> • Learn the historical developments in the field of Microbiology. • Understand the criteria used for classification of bacteria and their diversity. • Understand the modes of nutrition in bacteria and the methods to cultivate them. • Develop the basic knowledge of microbial growth and reproduction. • Apply the concepts of control of microorganisms by physical methods and by chemicals or chemotherapeutic agents. • Learn the environmental and ecological niche of microorganisms and their impact in environment. • Analyse the effect of microbial water pollution and learn the waste water treatment processes. • Develop knowledge about the role of micro-organisms in food and their impact on humans via food. 										
Credits	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Theory</th> <th style="width: 50%;">Practical</th> <th style="width: 50%;">Total</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">1</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">2</td> <td style="text-align: center;">5</td> </tr> </tbody> </table>	Theory	Practical	Total	3	1	4	3	2	5
Theory	Practical	Total								
3	1	4								
3	2	5								
Contact Hours	Time: 2h (Theory), 2h (Practical)									
Max. Marks: 100 (50 TE + 25 TI + 05 PI + 20 PE)										

*Part B- Contents of the Course
 Instructions for Paper-Setter*

Nine questions will be set in all. Question No. 1 comprising of objective/short answer type questions from the entire syllabus will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No. 1 & four others selecting one question from each unit. All questions carry equal marks.

CONTACT HOURS	
10	<p align="center"><u>UNIT I</u></p> <p>Fundamentals of microbiology: History and Evolution of Microbiology with special reference to the major scientific contributions.</p> <p>Microbial Classification & Diversity: Microbial taxonomy, criteria used for classifying bacteria including molecular approaches, current classification of bacteria.</p> <p>Microbial Diversity: Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Archaea, Algae, Fungi and Protozoa) with emphasis on distribution, occurrence and morphology.</p>
12	<p align="center"><u>UNIT II</u></p> <p>Ultrastructure of Bacteria: Cell envelope - capsule and slime layer, Cell-wall: Composition and detailed structure of Gram positive and Gram negative cell walls, mechanism of Gram's staining.</p> <p>Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cellular appendages - pili, flagella and fimbriae, inclusion bodies, Plasmid DNA and chromosomal DNA, Endospores and sporulation in bacteria.</p> <p>Viruses: General characteristics of viruses, structure, different shapes and symmetries with one example of each type, classification of viruses on the basis of nucleic acids with one example of each. Brief idea of lytic and lysogenic cycle.</p> <p>Microbial Cultivation and preservation: Nutritional categories of micro-organisms. Culture media and its types, methods of Isolation/Purification. Preservation and maintenance of pure cultures.</p>
12	<p align="center"><u>UNIT III</u></p> <p>Bacterial Genetics: Conjugation, transduction (generalized and specialized), and transformation.</p> <p>Microbial Growth: Growth curve, Generation time, synchronous, batch and continuous culture, measurement of growth and factors affecting growth of bacteria.</p> <p>Control of Microorganisms by Physical Agents: moist heat sterilization- Boiling, Pasteurization, Fractional sterilization and autoclave. Dry heat sterilization - Incineration and hot air oven.</p>

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<p>Filtration—Diatomaceous earth filter, Seitz filter, membrane filter and HEPA; Radiation: Ionizing radiation – γ-rays and non-ionizing radiation – UV rays</p>	<p style="text-align: center;">11</p> <p>UNIT V</p> <p>Control of Microorganisms by Chemical methods: Alcohols, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents.</p> <p>Control of Microorganisms by Chemotherapeutic agents: Source, utility and mode of action of major chemotherapeutic agents.</p> <p>Microbial ecology: Physical environments: microenvironment and niche, Interactions of microorganisms with living and non-living. Nutrient cycling interactions.</p> <p>Water Microbiology: Bacterial pollutants of water, coliforms and non-coliforms. Sewage composition and its disposal.</p>
<p>List of Practical:</p> <ol style="list-style-type: none"> 1. Rules to follow in Microbiology laboratory & To study the principle and applications of important instruments (Laminar air flow unit, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and biotechnology laboratory. 2. Staining method – simple staining, gram staining and negative staining 3. Staining of <i>Aspergillus niger</i> by lactophenol cotton blue. [<i>A. niger</i> from rotten citrus fruit] 4. Bacterial cell motility – hanging drop technique. 5. Determination of cell size by micrometry. 6. Preparation of cotton plugs for sterilization of media. 7. Preparation of culture media for bacteria, fungi and their cultivation. 8. Plating techniques: Spread plate, pour plate and streak plate. 9. Isolation of bacteria from soil, water and air. 	
<p>Part C-Learning Resources Suggested readings:</p> <ol style="list-style-type: none"> 1. Jay JM, Loessner MJ and Golden DA (2005). Modern Food Microbiology, 7th edition, CBS Publishers and Distributors, Delhi, India. 2. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's microbiology, McGraw-Hill Education. 3. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms, 13th edition, Pearson/Benjamin Cummings. 4. Pelczar MJ, Chan ECS and Krieg NR (1995). Microbiology, 5th edition, McGraw-Hill Book Company. 	

5. Stanier RY, Ingraham JL, Wheeler ML, and Painter FR. (2005). General Microbiology. 5th edition. McMillan.
 6. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An Introduction, Pearson Education.

Part A - Introduction			
II			
Semester	CELLULAR METABOLISM		
Name of the Course	ID5 : 240/BIOT/CC		
202	CELLULAR METABOLISM		
Course Learning Outcomes (CLO):			
<ol style="list-style-type: none"> Students will appreciate how the collection of thousands inanimate molecules that constitute living organisms interact to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the non-living thing. Students will basics of metabolism inculcating inside human body. Students will have knowledge how these small biomolecules attribute in constructing higher living organism. This will broaden their understanding of how biochemical changes relate to physiological alteration in the body. The study of biochemistry will provide thoughtful vision how abnormal functioning of these biomolecules can lead to adverse pathological conditions. Students will learn basic metabolic pathways that leads to energy generation, carbohydrates assimilation, oxidation of fatty acids etc. Abnormality in the functioning of these metabolic pathways is directly related with adverse medical conditions. Students will gain knowledge of several regulatory pathways that affects metabolic pathways. 			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Time: 2h (Theory), 2h (Practical)			
Max. Marks:100 (50 TE + 25 PI + 05 PE + 20 PE)			

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Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

CONTACT HOURS

UNIT I Metabolism Overview and Bioenergetics

- a) Metabolism overview & its terminology; metabolic pathways; catabolism versus anabolism, Central Pathways, Anaplerotic Pathways, Secondary pathways
- b) Key chemical reactions in metabolism (oxidation-reduction; ligation, isomerization; group-transfer; hydrolytic & addition-removal of functional groups)
- c) ATP as Universal Currency of Free Energy in Biological Systems
- d) Regulation of Metabolic Pathways

10

UNIT II Carbohydrate Metabolism

- a) Glycolysis (phases, enzymes involved and energetics); Fate of pyruvate under aerobic and anaerobic conditions: Muscle glycolysis and alcoholic fermentation. Oxidative Decarboxylation of Pyruvate to Acetyl-CoA
- b) Citric acid cycle or Krebs cycle (overview, enzymes involved, reaction steps, & its energetics); Amphibolic roles of the citric acid cycle; Modification of TCA cycle: Glyoxylate Cycle;
- c) Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and Glycogenesis.

12

UNIT III Lipid & Protein Oxidation

- a) Overview of fatty acids: General considerations, activation of fatty acids, reactions of fatty acid oxidation
- b) Oxidation of Even-chain Saturated Fatty Acids (Krebs's β Oxidation Pathway); Oxidation of Unsaturated Fatty Acids.




12

<p>c) Basis of Fatty Acids Biosynthesis: Acetyl-CoA transport into the cytosol. Production of malonyl-CoA. Intermediates in fatty acid synthesis and the ACP. The fatty acid synthase complex.</p> <p>d) Ketogenesis. General considerations, Biosynthesis, and utilization of ketone bodies. Ketogenic and anti-ketogenic substances; metabolic water</p>	<p style="text-align: center;">11</p> <p>UNIT IV Electron Transport & Oxidative Phosphorylation</p> <p>a) Electron flow as source of ATP energy; Site of oxidative phosphorylation; ATP synthetase</p> <p>b) Electron-transport complexes (respiratory chain); Proton motive force; Chemi-osmotic model</p> <p>c) Oxidation of extra-mitochondrial NADH (Malate-oxaloacetate-aspartate shuttle & Glycerophosphate-dihydroxyacetone phosphate shuttle)</p> <p>d) Respiratory Inhibitors: Inhibitors of electron transport; Inhibitors of oxidative phosphorylation; Uncouplers of oxidative phosphorylation; Ionophores of oxidative phosphorylation</p>
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- List of Practicals**
1. Preparation of buffers at a specific molarity and pH
 2. To demonstrate the formation of standard curve and its role in calculating concentration of an unknown sample.
 3. To estimate total protein in liver homogenate.
 4. To estimate the blood glucose level.
 5. To estimate serum creatinine level.
 6. To demonstrate fate of pyruvate under anaerobic conditions (alcoholic fermentation).
 7. To demonstrate endergonic and exergonic reactions.
 8. To construct energy yield in terms of ATP of aerobic oxidation of 2 moles of Glucose.
 9. To construct stoichiometric balance sheet and energy yield in terms of ATP of C 18 fatty acid oxidation.
 10. To learn about urine urea nitrogen test, its purpose, and result analysis.

Part C-Learning Resources

1. Fundamentals of Biochemistry by J.L. Jain (S. Chand & Company Ltd.)
2. The Foundations of Biochemistry by Lehninger

3. Biochemistry – J. M. Berg, J. L. Tymoczko, L. Stryer, 5th ed
4. Biochemistry-Reginald H. Garrett Charles M. Grisham 6th ed
5. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry, VI Edition. WH Freeman and Co.
6. Essentials Of Biochemistry, U. Satyanarayana, J. Chastropati, (2021). Publisher- Elsevier

Part A- Introduction		H (CORE)									
		Basics in MOLECULAR BIOLOGY									
Semester											
Name of the Course ID6: 240/BIOT/CC203											
Course Learning Outcomes (CLO):	After completing the course, the learner will be able to :										
	<ol style="list-style-type: none"> 1. Gain Knowledge about DNA as genetic material and various experiments leading to this discovery. 2. Understand process of replication in both prokaryotic and eukaryotic systems, various enzymes involved in the process and inhibitors of the replication 3. Gain Knowledge of mutations and its various types. They will get in depth knowledge regarding multiple repair systems present cellular level. 4. Get an insight into process of transcription in both prokaryotic and eukaryotic system, post transcriptional changes all the types of RNA. 5. Understand the Process involved in translation, various proteins required for the process, post translational modifications. 6. Acquire knowledge about regulation of gene expression. 										
Credits	<table border="1"> <thead> <tr> <th>Theory</th> <th>Practical</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>1</td> <td>4</td> </tr> <tr> <td>3</td> <td>2</td> <td>5</td> </tr> </tbody> </table>	Theory	Practical	Total	3	1	4	3	2	5	
Theory	Practical	Total									
3	1	4									
3	2	5									
Contact Hours	Time: 2h (Theory), 2h (Practical)										
Max. Marks:100 (50TE+ 25PI + 05 PI + 20PE)											

- e) Protein biosynthesis in prokaryotes and eukaryotes, post translational modifications, protein degradation, Inhibitors of protein synthesis.
- f) Regulation of gene expression (*lac* & *trp* operons)

List of Practical:

1. Isolation of genomic DNA from bacterial cells.
2. Isolation of total RNA from mammalian cells.
3. Estimation of DNA by diphenylamine reaction.
4. Estimation of RNA by orcinol method
5. Quantitative Estimation of DNA and RNA by UV Spectrophotometry
6. Estimate purity of DNA sample by calculating DNA/protein ratio.

Part C-Learning Resources

- a) David L. Nelson & Michael M. Cox, (2017) Lehninger principles of biochemistry (7th Edition) W H Freeman & Co.
- b) Lodish, H, Berk, A, Lawrence, A, Matsudaira, A, Baltimore, D and Demell, J. Molecular Cell Biology (Fourth Edition). W.H.Freeman and Company, 2009
- c) Cooper G M & Hausman E, The Cell - A Molecular Approach, (6th edition), Sinauer Associates 2013
- d) P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology, S.Chand & Company Ltd., New Delhi, 2012
- e) Lewin, B, GENES X, (10th edition), Jones & Bartlett Learning, 2011

SEMESTER-III

INTERDISCIPLINARY - BIOTECHNOLOGY

Part A - Introduction

III

BioAnalytical Tools

Semester

Name of the Course ID7 :

240/BIOT/CCS01

Course Learning Outcomes (CLO):

1. After completing this course, the learner will be able to acquire knowledge of analytical tools and techniques of biotechnology understanding of good laboratory practices.
2. The course will provide in depth knowledge of basic instruments involved in biological laboratory, so that the students can easily be acquainted as operators in several diagnostic laboratory.
3. Practical will provide Handling of general & specific problems while processing of experimental material and learn to devise solution by choosing appropriate methodology/techniques for processing of bio materials/products.
4. Students will exhibit the knowledge of testing of DNA/Proteins/Fingerprints/antibodies in the field of research of Biotechnology/Molecular Biology
5. Students will understand the biochemical techniques essential for working in a biotechnological laboratory.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
	Time: 2h (Theory), 2h (Practical)		
Max. Marks:100 100 (50TE+ 25PI + 05 PI + 20PE)			

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT I

Microscopy:

- a) Terms- Magnification, Numerical aperture, Resolving power, Refractive index
- b) Concept and working of Simple microscope

CONTACT HOURS

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c)Compound Microscope, Dark field microscope, phase contrast microscope, florescence microscope
 d)Electron microscopy (TEM and SEM)

UNIT II

Principle, laws and Applications of:

a) Colorimeter, Fluorimeter, Centrifuge, Spectrophotometer

b)Cell fractionation techniques: Isolation of sub-cellular organelles and particles, c)Differential centrifugation and , Density gradient centrifugation.

11

UNIT III

Introduction to the principle of chromatography:

a)Paper chromatography, thin layer chromatography.

b) Column chromatography: Silica Gel filtration, Affinity, Ion exchange chromatography.

c)Gas chromatography, HPLC

12

UNIT IV

Molecular Biology Techniques:

a)Introduction to Electrophoresis: polyacrylamide gel (native and SDS-PAGE) electrophoresis, Agrose-gel Electrophoresis

b) Immuno-electrophoresis, Isoelectric focusing, Western blotting, Southern and Northern Blotting, ELISA, DOT Blot Technique, Colony Hybridization, Microarray

c)Introduction of Biosensors, types and application

d) Nanotechnology and application

12

List of Practicals

1. Preparation of solution with specific concentration and pH
2. To perform Agarose gel electrophoresis and determination of molecular weight of DNA sample
3. To perform SDS Polyacrylamide Gel Electrophoresis of proteins
4. Separation of amino acids in given sample by paper chromatography
5. To identify sugars in given sample by TLC
6. To perform Column Chromatography, Gel filtration, Affinity Chromatography
7. To study Beer's Lambert Law by spectrophotometer
8. Demonstration of Biosensitivity and its model.

9. Preparation of nanoparticles in a given sample
 10. Precipitation of Sub Cellular Fractions from rat liver cell

Part C- Learning Resources

1. Lehninger Principles of Biochemistry by David L Nelson
2. Introductory Practical by S.K. Sahani and Randeer Singh
3. Practical Manual of Biotechnology by Raju Mahajan
4. Fundamentals of Techniques of Biophysics and Molecular Biology by Pranav Kumar
5. Principles and Techniques in Biochemistry and Molecular Biology by Wilson and Walker

Part A - Introduction	
Semester	III
Name of the Course ID8 : 240/BIOT/CC302	FUNDAMENTALS OF IMMUNOLOGY
Course Learning Outcomes (CLO):	
On successful completion of the course the students will gain and be able to demonstrate following knowledge:	
<ol style="list-style-type: none"> 1. Understand the concepts of Immunology, get an insight about the different kind of defence mechanism our body possesses for protection from various infections and diseases. 2. Learners will gain knowledge about how our immune system actually work and our body defence mechanism help us to fight against various infections and diseases. 3. Learners will get an insight of scope and applications of immunology in pharma and research sector. The students will be able to demonstrate the knowledge of applications of immunology for human welfare. 	


 Prof. Dr. P. K. Singh
 Head
 Department of Biotechnology
 J. J. Somaiya Institute of Technology and Management
 Mulund West, Mumbai - 401 333

3. Gain knowledge about the clinical immunology where they will learn about the different tests or methods to diagnose the different immune disorders, infections and diseases. Learners will also get an insight of treatment of immune disorders, various infections and diseases.

4. Gain knowledge of structure, working, maintenance/calibration and safety measures during handling of clinical lab instruments and chemicals. Also get insight of maintenance of aseptic conditions and proper disposal of biochemicals.

5. Gain knowledge about Vaccines and Recent Advances in development of vaccines.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100
(50T+25TI++0SPI+20PE)
Time: 2h (Theory), 2h (Practical)

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking three questions from each section. The candidates will be required to attempt Q.No.1 & four others selecting one questions from each section. All questions carry equal marks.

UNIT I

- **Immunology:** Introduction, History and Scope, Terminology of immune system
- **Immunity:** Definition, Types of Immunity: Innate, Adaptive/acquired (active, passive, natural/artificial, Humoral and Cell mediated immunity), Features of Immune Response - memory, cell specificity, diversity, recognition of self and nonself, clonal nature of immune response.

CONTACT HOURS

12


<p>clonally selected T cells and their effector functions, concepts of T-helper 1 (TH1) and T-helper 2 (TH2) cell.</p>	<p style="text-align: right;">10</p> <p style="text-align: center;"><u>UNIT IV</u></p> <ul style="list-style-type: none"> • Hypersensitivity Reactions: Types (I-IV), brief description and clinical relevance. • Introduction, history and different types and generations of vaccine: Principles of vaccination, passive & active immunization, I generation or traditional vaccine (live attenuated and inactive killed vaccine), II generation (toxoid, subunit and conjugate vaccine), III generation (recombinant, DNA, mRNA, viral vector), IV generation or next generation vaccine (synthetic peptide and Nano vaccine, Autologous and personalised vaccine) herd immunity • Immunotherapy: Basic concept of immunotherapy including monoclonal antibodies. <p>List of Practical:</p> <ol style="list-style-type: none"> 1. Agglutination test: Blood grouping by agglutination, pregnancy test. 2. ELISA (Enzyme-Linked Immunosorbent Assay): Detection of specific antibodies or antigen. 3. Hemoglobin Count. 4. RBC Count. 5. Total leukocyte count (TLC). 6. Differential leukocyte count (DLC). 7. Immunodiagnostic tests for diseases (e.g. Widal). 8. Ouchterlony double diffusion (ODD) technique. <p>Part C-Learning Resources</p> <ol style="list-style-type: none"> 1. Kuby Immunology: Sharon Strunford, Judith A Owen, Jenni punt, Patricia Jones. 2. Biotechnology: extending horizon B. D. Singh 3. IIT: Introduction to Biotechnology: Arunoka Jaini 4. Immunology and Microbiology: N. Arumugam, L.M. Narayanan, Duby Fatima 5. Biotechnology practical handbook: Anand Kumar 6. Text book of Immunology: Anand Kumar
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Part A - Introduction			
Semester	III Core Course		
Name of the Course ID9: 240/BIOT/CC303	BASIC ENZYMOLOGY		
Course Learning Outcomes (CLO):	<ul style="list-style-type: none"> • The students will be able to assign systemic name to enzymes and from the E.C. number they can explain the reaction it catalyses. • The students will be able to understand the concept of importance of kinetics of enzyme, its inhibitions and how they influence normal physiology and drug action • The students have a deeper insight in to the fundamentals of enzyme structure, function, and chemical nature of enzymes. Discussion on current applications and future potential of enzymes. 		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks:75 (35TE+ 15PI + 5PI + 20PE)	Time: 2h (Theory), 2h (Practical)		

Part B- Contents of the Course

Instructions for Paper-Setter

Total five questions will be set. Question 1 comprising objective/ short answer type will be compulsory and of 9 marks. The remaining six questions will be set taking two questions from each unit. Students


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must attempt total four questions including Q1 (compulsory) and three questions taking one from each unit. Q1 will be of 8 marks and remaining questions of 9 marks.	CONTACT HOURS
<p>UNIT-I Nomenclature and Classification</p> <p>a) Historical resume; Nomenclature and classification; major features of I.U.B classification system; knowledge of various terms such as holoenzyme, apoenzyme, co-enzyme, prosthetic group, co-factors, ribozymes, abzymes, metalloenzymes, monomeric & oligomeric enzymes, Isozymes, of Isozymes; Biological Roles of Enzymes (Endo- and exo-enzyme)</p> <p>b) Chemical Nature of Enzymes; Characteristics of Enzymes (colloidal nature, catalytic nature, turnover number, Specificity of enzyme action, thermolability- denaturation and renaturation)</p> <p>c) Understanding of Energy Mechanics of Enzymatic Reactions (standard free energy, ground & transition state, activation energy, energy diagram of reaction, rate limiting step, feed-back inhibition, zymogen)</p>	10
<p>UNIT-II Mechanism of Enzymic Action</p> <p>a) Michaelis-Menten Hypothesis; Derivation Michaelis-Menten equation; Michaelis constant, Significance of K_m and V_m values)</p> <p>b) Active Site & its detailed features: Fischer's lock and key model; Koshland's induced fit model</p> <p>c) Reversible enzyme inhibition (Competitive inhibition, Non-competitive inhibition, and Uncompetitive inhibition)</p>	10
<p>UNIT-III Coenzymes, Enzymes and their Applications</p> <p>a) Co-enzymes: Mechanism of action of important coenzymes NAD, FAD, FMN, TPP, Pyridoxal sulphate, lipoteic acid, α-SH and vitamin B12</p> <p>b) Methods of enzyme immobilization and applications of immobilized enzymes</p>	10

c) Applications of enzymes in food, sugar, dairy, detergent, health industry, medicine & diagnostics.

List of Practicals

1. Demonstration of Starch Digestion by Salivary Amylase at optimum conditions.
2. To demonstrate effect of pH on enzyme activity.
3. To demonstrate effect of temperature on enzyme activity.
4. To demonstrate the effect of inhibitors on the action of enzyme.
5. To study the activity of trypsin in cell culture.
6. Assay of Enzyme Activity and Specific Activity e.g. Acid Phosphatase.
7. Partial Purification of Acid Phosphatase from Germinating (Mung) Beans by Ammonium Sulphate Fractionation.

Part C-Learning Resources

1. Fundamentals of Biochemistry by J.L. Jain (S. Chand & Company Ltd.)
2. The Foundations of Biochemistry by Lehninger
3. Understanding enzymes; Palmer T, Ellis Harwood Ltd., 2nd ed
4. Enzyme structure and mechanism. Alan Fersht, Freeman & Co 2nd ed
5. Enzyme kinetics Siegel Inter-science – Wiley
6. <https://egyankosh.ac.in/bitstream/123456789/71261/1/BCCCL-108.pdf>

SEMESTER-IV

INTERDISCIPLINARY - BIOTECHNOLOGY

Semester

Part A - Introduction

IV



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Name of the Course/ID: 240BIOT/CC-101		Basics of Recombinant DNA Technology	
Course Learning Outcomes (CLO): After completing this course, the learner will be able to:			
1. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.			
2. To expose students to application of recombinant DNA technology in biotechnological research.			
3. To train students in strategizing research methodologies employing genetic engineering techniques.			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Time: 2h (Theory), 2h (Practical)			
Max. Marks:100 (50TE+25TI+05PI+20PD)			

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

CONTACT HOURS

UNIT I	CONTACT HOURS
Recombinant DNA Technology and Genetic Engineering: Introduction, history, scope and applications. Tools of Recombinant DNA technology: Steps in gene cloning. Gene cloning tools – Restriction and methylation system in prokaryotes & its application. DNA Ligases, DNA polymerases, alkaline phosphatase and reverse transcriptase. Gene Cloning Vectors: Introduction, nomenclature of vectors, properties of a suitable vector. Plasmid vectors (pBR322, pUC18), bacteriophage vectors (lambda, M13), cosmids, plasmids and Plasmids. Yeast vectors, Shuttle vectors, YAC and BACs. Overview of Expression vectors.	12

<p style="text-align: center;"><u>UNIT II</u></p>	<p>In vitro construction of r-DNA molecules: Isolation of gene of interest and vector DNA, and their ligation, cohesive and blunt ends, modification of cut ends, linkers and adaptors. Integration of DNA inserts into the vectors.</p> <p>Gene Transfer Techniques: Microinjection, Electroporation, Shot Gun method, Ultrasonication, Lipofection, CaCl₂ mediated transformation, competent cells.</p>	12
<p style="text-align: center;"><u>UNIT III</u></p>	<p>Selection & Screening of cloned genes: Screening of transformants and their characterization. Selection of clone having the specific DNA insert - immunological screening, colony hybridization, and nucleic acid hybridisation methods. Marker genes- selectable markers.</p> <p>Gene Libraries: Construction of Genomic and cDNA library, advantages and limitations, screening of gene libraries.</p>	10
<p style="text-align: center;"><u>UNIT IV</u></p>	<p>DNA amplification through PCR: Basic features and applications of PCR, RT-PCR.</p> <p>Changing genes: Site-directed mutagenesis: Random mutagenesis. Cassette mutagenesis, PCR based site directed mutagenesis.</p> <p>List of Practical:</p> <ol style="list-style-type: none"> 1. Genomic DNA isolation from plants and animals. 2. Plasmid DNA isolation from <i>E. coli</i>. 3. Spectrophotometer analysis of DNA 4. Agarose gel electrophoresis of DNA 5. Restriction digestion of DNA 6. Ligation of DNA fragments. 7. Preparation of competent cells. 8. Transformation of competent cells. 9. Replica plating and Blue white selection. 	11

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10. Amplification of DNA by PCR using random primers

Part C-Learning Resources:

1. S. B. Primrose, R. Twyman. Principles of Gene Manipulation and Genomics (Wiley-Blackwell, ed. 7, 2006).
2. M. Wink. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology (Wiley, ed. 2, 2011).
3. B. R. Click, et al. Molecular Biotechnology: Principles & Applications of Recombinant DNA (ASM Press, ed. 4, 2009).
4. DNA cloning: A Practical Approach. Glover and Hames (2001) Oxford University Press.
5. Genetic Engineering. Ahluwalia, K. B. (2002) New Age International (P) Ltd.
6. Brown, T. A. (2006). Gene cloning and DNA analysis (5th ed.). Oxford, UK: Blackwell Publishing.
7. Clark, D. P. & Pazdernik, N. J. (2009). Biotechnology - applying the genetic revolution. USA: Elsevier Academic Press.

Part A- Introduction			
Semester	IV		
Name of the Course	Introduction to MEDICAL MICROBIOLOGY		
Course Learning Outcomes (CLO):	<p>On completion of the course students are able to :</p> <ol style="list-style-type: none"> 1. Learn about historical development of Medical microbiology 2. Will understand the mechanisms of infectious diseases caused by bacteria, virus, fungi, and protozoa 3. Learn about Normal microflora of human body, nosocomial infections, biosafety 		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100	Time: 2h (Theory), 2h (Practical)		
100 (50 TE + 25 PI + 05 PE)			

Part B- Contents of the Course

Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus, will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal-marks.

UNIT	CONTACT HOURS
<p>Introduction to medical microbiological terminologies</p> <ul style="list-style-type: none"> • Types of infections: Primary, secondary, cross, endogenous, exogenous, congenital, teratogenic, iatrogenic, laboratory and latent infections • Carriers and transmission of diseases: Types & Methods of transmission. • Definitions of: MD, ID50, MLD, LD50, Bacteraemia, Septicaemia, contagious, Endemic, epidemic, pandemic, sporadic and prozodemic diseases, Communicable and non-communicable diseases, Epizootic, Enzootic • Normal micro flora of human body • Nosocomial infections <p>Morphology, virulence factors, pathogenesis, symptoms, laboratory diagnosis & preventive measures of</p> <ul style="list-style-type: none"> • Gram-Positive Cocci: <i>Staphylococcus aureus</i>, <i>Streptococcus pyogenes</i>. • Gram-Negative Cocci: <i>Neisseria (N. gonorrhoeae, N. meningitidis)</i> 	10
<p>UNIT II</p> <p>Morphology, virulence factors, pathogenesis, symptoms, laboratory diagnosis & preventive measures of</p> <ul style="list-style-type: none"> • Gram-Positive Bacilli: <i>Bacillus anthracis</i>, <i>Clostridium botulinum</i>, <i>C. tetani</i>, <i>Corynebacterium diphtheriae</i>. • Gram-Negative Bacilli: <i>Escherichia coli</i>, <i>Klebsiella pneumoniae</i>, <i>Salmonella typhi</i>, <i>Shigella dysenteriae</i>, <i>Pseudomonas aeruginosa</i>, <i>Vibrio cholera</i>. • Rickettsia and Chlamydia: Brief account 	12

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UNIT III

Morphology, virulence factors, pathogenesis, symptoms & preventive measures of

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- **Acid-Fast Bacteria:** *Mycobacterium tuberculosis*, *Mycobacterium leprae*
- **Spirochetes:** *Treponema pallidum* (Syphilis)
- **Protozoan Infections:** *Entamoeba histolytica*, *Taenia solium*, *Ancylostoma deudendale*, *Giardia lamblia*, *Leishmania donovani*, *Trypanosoma brucei*, *Plasmodium*.

Medical Mycology: Superficial Mycoses (Tinea), Subcutaneous & Systemic Mycoses (*Aspergillus*, *Candida*).

UNIT IV

Morphology, pathogenesis, symptoms & preventive measures of

11

- **Major viral disease** - Chicken pox, Influenza, measles, Mumps, Rubella, Rabies, Hepatitis A, B & C, AIDS, Polio.
- **Emerging & Re-Emerging Viruses** (Ebola, Zika, SARS-CoV-2)

List of Practical:

1. To study antibiotic sensitivity of microbes by Kirby Bauer's method/ development of an antibiogram
2. Identification of given samples by biochemical characterization using IMVIC, TSI and Nitrate test.
3. Enzymatic and biochemical tests for Bacteria: Catalase Test, Oxidase Test, Urease Test, Coagulase Test, Bile solubility test.
4. Identification and characterization of Normal microflora of nose/ mouth/ skin.
5. Demonstration of Serological test- ELISA.
6. Study of various stages of Malarial parasite in RBCs using permanent mounts/Photomicrographs.
7. Demonstration of cultivation of viruses in embryonated chicken eggs.

Part C-Learning Resources Suggested readings:

1. Sallie A.J. Fundamental Principles of Bacteriology. Tata McGraw-Hill Education
2. Willey, J., Sherwood, L. and Woolverton, C. J. (2017) Prescott's microbiology, McGraw-Hill Education.
3. Kamunge R. (Editor) Ananthanarayan and Paniker's Textbook of Microbiology. University Press.
4. Pelczar MJ, Chan ECS and Krieg NR. (1993): Microbiology. 5th edition. McGraw Hill Book Company.
5. Tortora, G. J., Funke, B. R. and Case, C. L. (2016) Microbiology: An introduction, Pearson Education.
6. Subhash Chandra Parija, A Textbook of Microbiology & Immunology, (2023) (Elsevier)
7. Dubey and Maheshwari, A textbook of Microbiology, S Chand Publication

Semester	IV		
Name of the Course ID12: 240/BIOT/CC403	Introduction to ANIMAL BIOTECHNOLOGY		
Course Learning Outcomes (CLO):			
a) Students will gain a comprehensive understanding of the principles and applications of biotechnology in the context of animal science.			
b) Students will be familiar with the methods and applications of animal cell culture, including stem cell technology.			
c) They will understand and be able to apply techniques like in vitro fertilization, embryo transfer, and other reproductive manipulation methodologies.			
d) Students will understand the ethical considerations and implications of using biotechnology in animal production and research.			
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 (50TE+ 25TI + 05 PI + 20PE)	Time: 2h (Theory), 2h (Practical)		

Part B- Contents of the Course

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Instructions for Paper-Setter

Nine questions will be set in all. Question No.1 comprising of objective/short answer type questions from the entire syllabus will be compulsory. The remaining eight questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & four others selecting one question from each unit. All questions carry equal marks.

UNIT I Animal Cell Culture	CONTACT HOURS
<ul style="list-style-type: none"> a) Introduction, history, and scope of Animal cell culture, primary cell culture & established cell lines, monolayer cell culture & suspension culture, types of substrates used for animal cell culture b) Culture Media for Animal Cells and Tissue - Natural & Synthetic (serum containing media, serum free media, chemically defined media) c) Basic techniques of mammalian cell culture preparation: disaggregation of animal tissues (mechanical, enzymatic and EDTA) 	10
<p>UNIT II Animal propagation</p> <ul style="list-style-type: none"> a) Artificial insemination (AI)- introduction, evaluation of semen, dilution and preservation of semen, procedure of insemination, advantages of AI, disadvantages, and challenges b) Embryo transfer technology (MOT) - introduction, principle, detailed steps involved including embryo recovery, evaluation, preservation c) Somatic and Reproductive cloning - concept, history, and types, Somatic cell nuclear transfer, story of Dolly & associated challenges 	12
<p>UNIT III Transgenic Animals</p> <ul style="list-style-type: none"> a) Introduction to transgenesis, Objectives & Application of transgenesis b) Production of transgenic Mammals - Mice, Cow, Sheep, & Goat; applications with specific examples c) Production of transgenic Bird, Insects and Fishes; applications with specific examples d) Production of useful proteins in transgenic animals and molecular farming 	12
<p>UNIT IV Genetic Modification in Medicine</p> <ul style="list-style-type: none"> e) Role of animal model in experimentation (disease model; drug assessment model, therapeutic cloning) 	11

<p>f) Introduction and Principle of Gene therapy, Gene Therapy Strategies (gene augmentation therapy, targeted killing of specific cells, targeted mutation correction, targeted inhibition of gene expression), Approaches of gene transfer in gene therapy (ex-vivo and in-vivo)</p> <p>g) Introduction to Stem Cell Technology and its applications.</p>	<p>List of Practicals</p> <ol style="list-style-type: none"> 1. Preparation of animal cell culture media. 2. Preparation of primary cell culture from fresh animal tissue (liver). 3. Dye exclusion assay- Trypan blue assay and cell counting using hemocytometer. 4. Isolation of PBMCs from whole blood using density gradient medium centrifugation process. 5. Preparation of in-vitro culture of isolate human PBMCs. 6. To demonstrate the protocol of freezing, cryopreservation and thawing of primary culture. 7. Genomic DNA extraction from animal cells 8. Demonstration of working model on ex-vivo and in-vivo gene therapy.
<p>Part C-Learning Resources</p> <ol style="list-style-type: none"> 1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA (4th edition) 2. B. D. Singh, Biotechnology: Expanding Horizons (4th edition) 3. Tom Strachan & Andrew P. Read, Human Molecular Genetics, 2nd edition, Garland Science, (2004) 4. R. Ian Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6th Edition) 5. T. A. Brown Gene Cloning and DNA analysis 	

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Vocational Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is focused on practical work, preparing students for a particular skilled profession.

Semester 4

Course Code	Course Title	Course ID	L T P			Credits	P	MARKS				
			L (Hrs)	T	P			TI	TE	PI	PE	Total
VCC-1	Food Processing	240/BIO/VO C401	2	-	4	2	4	15	35	15	35	100

Semester 5

Course Code	Course Title	Course ID	L T P			Credits	P	MARKS				
			L (Hrs)	T	P			TI	TE	PI	PE	Total
VCC-2	Introduction to Molecular Diagnostics	240/BIO/VO C501	2	-	4	2	4	15	35	15	35	100

Semester 6

Course Title	Course ID	L	T	P	P	Credits	MARKS				
							TI	TE	PI	PE	Total

Seven questions will be set in all. Question No.1 comprising of objective short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking two questions from each unit. The candidates will be required to attempt Q.No.1 & three others selecting one question from each unit. Question no.1 carry 8marks and other questions carry 9 marks each.

UNIT	CONTACT HOURS
<p>UNIT I</p> <p>Introduction to Food Processing and Preservation- Definition, Historical evolution, current status of food processing, scope and future of food processing, Primary vs. secondary processing, perishable and non-perishable foods, causes of food spoilage.</p> <p>Preservation of foods by Preservatives: chemicals (natural and synthetic), antioxidants, acidulants etc.</p> <p>Preservation by non-preservatives: salt-pickling, sugar-jams, jellies and marmalades</p> <p>Preservation by radiation: Definition, equipment, measurement of dose, effect on micro-organisms, effect on foods</p>	<p>10</p>
<p>UNIT II</p> <p>(a) Thermal processing: Canning (definition, time-temperature combination and equipments), Blanching (definition, sodium blanchers, hot water blanchers, effect on food-nutrient, colour, flavour and texture) Pasteurization (definition, pasteurisation of packaged food and unpackaged foods, effect on food-colour and flavour, vitamin loss) Use of low temperature: Chilling, cold storage, freezing Air freezing, plate freezing, liquid immersion, Freezing and cryogenic freezing Freezer selection. Advantages and disadvantages of freezing and changes in food during freezing storage</p>	<p>10</p>
<p>UNIT III</p> <p>Preservation by drying: Principles, Methods and effect on quality, air solar drying, Cabinet drying, tunnel dryer, spray dried, freeze-dried, freeze-dried food, hot air drying, microwave, heat and mass transfer, change</p>	<p>10</p>

Recent methods employed in preservation: (theory, equipment, effect on micro-organisms) of- Pulsed electric field processing, high pressure processing, processing using ultrasound, dielectric, ohmic and infrared heating.

List of Practicals:

1. Tips for successful food processing practicals: hygiene, safety and record keeping
2. Experimenting with natural and artificial preservatives
3. Making food preserve using salt-pickling
4. Making fruit preserves, jams, jellies or marmalades.
5. Sun drying, air drying, or using a dehydrator for fruits, vegetables, and herbs.
6. Learn low blanching vegetables and fruits before freezing helps preserve their colour, texture, and nutritional value.
7. Performing shelf-life tests with different packaging methods
8. Visit to food processing unit

Part C-Learning Resources:

1. Food Processing: Principles and Applications by Ramaswamy H. & Marcotte M. Taylor & Francis.
2. NCERT textbook, chapter on food processing(<https://ncert.nic.in/textbook/pdf/lehe10-4>)
3. <https://www.icsi.in/blog/different-types-and-methods-involved-in-food-processing>
4. Principles of Food Processing, Richard W Hartel, Dennis R. Heldman, Aspen publication
5. Food processing engineering and technology by Zeki Berk Professor, Elsevier publication
6. Food processing: principles and applications/edited by Scott Smith and Y.H Hui 1st Edition, Blackwell Publishing

Practical
Practical

Minor Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)
Semester 1

Course Code	Course Title	Course ID	L T P			Credits	MARKS				
			(Hrs)				TI	TE	PI	PE	Total
MIC-1	Fundamentals of Biotechnology	240BIOT/MI C101	1	2	1	2	5	20	5	20	50

Semester 2

Course Code	Course Title	Course ID	L T P			Credits	MARKS				
			(Hrs)				TI	TE	PI	PE	Total
MIC-2	Introduction to Gene Cloning	240BIOT/MI C201	1	2	1	2	5	20	5	20	50

Semester 3

Course Code	Course Title	Course ID	L T P			Credits	MARKS				
			(Hrs)				TI	TE	PI	PE	Total
MIC-3	Applications of Biotechnology	240BIOT/MI C301	3	2	3	4	25	50	5	20	100

Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks: 10 (05 Theory + 05 Practical) End Term Exam Marks: 40 (20 Theory + 20 Practical) Time: 2h (Theory), 2h (Practical)			

Part B- Contents of the Course

Instructions for Paper-Setter

Seven questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking five questions from each heading. The candidates will be required to attempt Q.No.1 & any three other questions. All questions carry equal marks.

Biotechnology: Definition, different types and colors (white, red, green, blue) of biotechnology, biotechnology as an interdisciplinary pursuit, scope and future of biotechnology; Biotechnology research in India, Biotechnology in context of developing world.
Genetic engineering: Introduction of genetic engineering and basic concept of genetically modified organisms. History of genetic manipulations.
Application of biotechnology: Application of biotechnology in agriculture; food industry, pharmaceutical industry, forensic analysis, environment protection.
Role of biotechnology in allied fields: Bioinformatics, Nanotechnology and Biosensor
IPR and Bioethics: a brief account on Intellectual property rights and Ethical issues related to Biotechnology.

15

CONTACT HOURS

List of Practical:

1. To study the different methods of sterilization and maintenance of aseptic conditions of biotech labs.
2. Study of structure, working and maintenance of lab instruments: Autoclave, Bio air oven, pH meter, laminar airflow and centrifuge.

Multidisciplinary Course from the department for pool of the Courses in the University
(These courses are to be offered to students of different discipline/Subject) Biotechnology

Semester 1

Course Code	Course Title	Course ID	Credits						MARKS				
			L		T		P		TI	TE	PI	PE	Total
			(Hrs)										
MDC-1	Wonders of living organisms: Structural Insights	240/BIOT/MD C101	2	-	2	-	1	3	15	35	5	20	75

Semester 2

Course Code	Course Title	Course ID	Credits						MARKS				
			L		T		P		TI	TE	PI	PE	Total
			(Hrs)										
MDC-2	Human Biochemistry and Genetics	240/BIOT/MD C201	2	-	2	-	1	3	15	35	5	20	75

Semester 3

Course Code	Course Title	Course ID	Credits						MARKS				
			L		T		P		TI	TE	PI	PE	Total
			(Hrs)										
MDC-3	Power of Immune System	240/BIOT/MD C301	2	-	2	-	1	3	15	35	5	20	75


 P. S. Srinivasan
 P. S. Srinivasan

	CONTACT HOURS
<p>Unit I: Structure and Function of Cell</p> <p>a) Cell theory, its origin and cell as the basic unit of life: Basic Structure of prokaryotic and eukaryotic cells (Plant cell and Animal cell)</p> <p>b) Cell organelles - mitochondria, chloroplast, ribosomes, endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles, and nucleus.</p> <p>c) Cell cycle, mitosis, meiosis, and their significance</p>	10
<p>Unit II: Structural Organization of Animal Body</p> <p>a) Basic understanding of different levels of organization in animals (cellular level, tissue level, organ level, organ system level, organism level). Importance of level of organization in animals.</p> <p>b) Parameters of animal diversity (symmetry, diploblastic and triploblastic organization; Coelom; Notochord</p>	10
<p>Unit III: Structural Organization of Plant Body</p> <p>a) Levels of organization in plants (meristematic and permanent tissue; simple and complex plant tissue; shoot organ system and root organ system)</p> <p>b) Parts of a flower body and its function.</p> <p>c) Zones of roots and its types</p>	10
<p>List of Practical:</p> <ol style="list-style-type: none"> 1. Study of simple compound microscope: its parts and focusing. 2. Study and compare the prokaryotic and eukaryotic cell. 3. Study and compare the animal and plant cell microscopic slides. 4. Study different stages of mitosis (microscopic view) 5. Compare different parameter of animal organization in hydra, star fish, frog, and human. 6. Study and describe different zones of roots. 7. Study types of roots (tap and adventitious). 8. Study and describe different structural component of <i>Hibiscus</i> flower. 9. Study of leaf (arrangement, shape, venation, simple and compound). 	
<p>Part C-Learning Resources</p> <p>Suggested readings:</p> <ol style="list-style-type: none"> 1. https://www.geeksforgeeks.org/levels-of-organization-in-animals/ 2. Biology Text Book for class XI published by NCERT. https://ncert.nic.in/textbook.php?kebo1=0-19 	


 S. Srinivas
 Prof. Dr. S. Srinivas

 S. Srinivas

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2. Fundamentals of Biology: CBSE Class 11 published by Wiley
3. I.S.C. Practical Biology (Including Viva-Voce & Project Work) Class- XI by V.P. Aggarwal and S.C. Maheshwari

Part A - Introduction		
Semester	II	
Name of the Course : 240/BIOT/MD201	Human Biochemistry and Genetics	
Course Learning Outcomes (CLO): After completing this course, the learner will be able to:	<ol style="list-style-type: none"> 5. Students should grasp the basic knowledge and function of key biomolecules (proteins, carbohydrates, lipids, and nucleic acids). 6. Students learn about the different components of energy expenditure, recognize positive and negative energy balance, and planning of healthy diet 7. Analyze personal food intake and activity patterns to identify areas for improvement. 8. Students understand the principles of inheritance; genes interaction to produce phenotypes; role of genetic counselling 	
Credits	Theory	Practical
	2	1
Contact Hours	2	2
Max. Marks: 75 (35TE + 15TI + 20PE + 5PI)	Time: 2 H (Theory), 2h (Practical)	
Total	3	
	4	

Part B- Contents of the Course

Instructions for Paper-Setter

Seven questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus will be compulsory. The remaining six questions will be set taking two questions from each section. The candidates will be required to

S. Maheshwari
Paper Setter
S. Maheshwari

Minor Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)

Semester 1

Course Code	Course Title	Course ID	L T P			Credits	MARKS						
			L (Hrs)	T	P		TI	TE	PI	PE	Total		
MIC-1	Fundamentals of Biotechnology	240/BIOT/MI C101	1	-	2	1	1		5	20	5	20	50

Semester 2

Course Code	Course Title	Course ID	L T P			Credits	MARKS						
			L (Hrs)	T	P		TI	TE	PI	PE	Total		
MIC-2	Introduction to Gene Cloning	240/BIOT/MI C201	1	-	2	1	1		5	20	5	20	50

Semester 3

Course Code	Course Title	Course ID	L T P			Credits	MARKS						
			L (Hrs)	T	P		TI	TE	PI	PE	Total		
MIC-3	Applications of Biotechnology	240/BIOT/MI C301	3	-	2	3	1	4	25	50	5	20	100

Signature

Signature

in Agriculture & Environment														
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Semester 6

Course Code	Course Title	Course ID	L T P				Credits	MARKS					
			L	T	P	(Hrs)		TI	TE	PI	PE	Total	
MIC-6	Industrial Microbiology	240/BIOT/MIC601	3	-	2	3	1	4	25	50	5	20	75

Minor Course

Semester	I
Name of the Course ID: 240/BIOT/MIC101	Fundamentals of Biotechnology
<p>Course Learning Outcomes (CLO): On successful completion of the course the students will gain and be able to demonstrate following knowledge:</p> <ol style="list-style-type: none"> 1. Understand the concepts of biotechnology and get an insight of how biotechnology is related to other sciences. 2. Gain knowledge about the scope and applications of biotechnology. Get an insight of scope and applications of biotechnology in agriculture, environment, food and pharma and other industries. 3. Gain knowledge about genetic manipulations, recombinant DNA technology and genetic engineering. 4. Gain knowledge about the role of biotechnology in Bioinformatics, Nanotechnology and other allied fields 5. Gain knowledge of structure, working, maintenance/calibration and safety measures during handling of biotech lab instruments and biochemicals. Also get insight of maintenance of aseptic conditions and proper disposal of biochemicals. 6. Gain knowledge about intellectual property rights and ethical issues related to biotechnology. 	

P. Arora

P. Arora

Credits	Contact Hours		Total
	Theory	Practical	
	1	1	2
Max. Marks:50	1	2	3
Internal Assessment Marks: 10 (05 Theory + 05 Practical)	Time: 2h (Theory), 2h (Practical)		
End Term Exam Marks: 40 (20 Theory + 20 Practical)			

Part B- Contents of the Course

Seven questions will be set in all. Question No.1 comprising objective/short answer type questions from the entire syllabus, will be compulsory. The remaining six questions will be set taking five questions from each heading. The candidates will be required to attempt Q.No.1 & any three other questions. All questions carry equal marks.

Biotechnology: Definition, different types and colors (white, red, green, blue) of biotechnology, biotechnology as an interdisciplinary pursuit, scope and future of biotechnology, Biotechnology research in India, **Biotechnology in context of developing world.**
Genetic engineering: Introduction of genetic engineering and basic concept of genetically modified organisms. History of genetic manipulations.
Application of biotechnology: Application of biotechnology in agriculture, food industry, pharmaceutical industry, forensic analysis, environment protection.
Role of biotechnology in allied fields: Bioinformatics, Nanotechnology and Biosensor.
IPR and bioethics: a brief account on Intellectual property rights and Ethical issues related to Biotechnology.

CONTACT HOURS
15

List of Practical:

1. To study the different methods of sterilization and maintenance of aseptic conditions of biotech labs.
2. Study of structure, working and maintenance of lab instruments: Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.

S. S. Srinivasan

P. Srinivasan

3. To study working, maintenance, calibration and precautions during handling of pH-meter, weighing balance, microscopes and other miscellaneous biotech lab instruments.
4. Preparation of normal, molar, percent solutions.
5. Preparation of buffer solutions and determination of their pH.
6. Precautions in handling of biochemicals and study of their proper disposal after use.
7. Visit to biotechnology lab.

Part C-Learning Resources

1. Biotechnology: expanding horizons- B. D. Singh
2. Elements of Biotechnology- PK Gupta
3. Biotechnology for beginners- Reinhard Renneberg Academic Press
4. BBB: Basics of Biology and Biotechnology- NM Jain
5. Introduction to Biotechnology-NM Jain
6. Biotechnology 5th edition- Johan E. Smith

Part A - Introduction			
Semester	2	Introduction to Gene Cloning	
Name of the Course ID: 240/BIOT/MIC201			
Course Learning Outcomes (CLO):			
After completing this course, the learner will be able to:			
1. Understand concept and scopes of Genetic Engineering and role of recombinant DNA technology in all fields of Biotechnology.			
2. Acquire the knowledge of basic concepts and methods for gene cloning, isolation, transformation and selection of desired clones.			
3. Understand the concepts and methodology of PCR and its uses in diverse fields of life sciences.			
4. Get acquainted with different tools and techniques used in Genetic Engineering experiments and manipulate DNA for its diverse use in different Biotechnology areas.			
Credits		Theory	Practical
		1	1
		1	2
		Total	Total
		2	3
Contact Hours			

Dr. P. Gupta

Dr. P. Gupta

Max. Marks:

50 (5TI+ 20TE + 05 PI + 20PE)

Time: 2h (Theory), 2h (Practical)

Part B- Contents of the Course

Instructions for Paper-Setter

Total six questions will be set. Question 1 comprising objective/ short answer type will be compulsory. The remaining five questions will be set from the entire syllabus. Students have to attempt total four questions including Q1 (compulsory) and three questions out of remaining five questions. All questions carry equal marks.

- **Gene Cloning Vectors:** General features, Types of cloning vectors-Plasmid, bacteriophage, phagemid, cosmid,
- **Gene Modifying Enzymes:** Restriction endonucleases (R.E.) Recognition sequence, blunt and sticky ends, applications, Ligases, Linker, Adaptor, Homopolymer tailing, Nick translation system. Construction of recombinant DNA,
- **Gene Recombination and Gene transfer:** Preparation of competent cell, Gene transfer using Plasmids. Transformation, Selection of transformed cells, Selection and Screening of Recombinants
- Direct selection, Preparation and comparison of Genomic and cDNA library
- Principle and applications of Polymerase chain reaction (PCR)
- **Applications of Genetic Engineering**

CONTACT HOURS

15

Practicals:

1. To perform plasmid isolation from *E.coli*
2. Isolation of genomic DNA from bacteria /plant
3. To perform PCR with given template and primers
4. To perform Restriction digestion of given DNA sample.
5. Performing alkaline phosphatase and ligation reaction of two DNA fragments.
6. Preparation of competent cells

Practicals
Practicals
Practicals

attempt Q.No.1 & three others selecting one question from each section. Question 1 will be of 8 marks and remaining questions of 9 marks.

Unit I: Biochemical metabolism and architecture:

- a) overview of metabolism (catabolism and anabolism)
- b) Key characteristics & roles of carbohydrates in body (glucose vs fructose; starch, glycogen, and cellulose)
- c) Key characteristics & roles of Proteins in body (building blocks amino acids-essential vs non-essential; enzymes)
- d) Key characteristics & roles of nucleic acids (types, hereditary unit)
- e) Key characteristics & roles of lipids (Fats vs oil; cholesterol; energy storage)

10

Unit II: Energy Balance and Hormones

- a) Overview of energy balance, factors influencing energy balance, role of healthy diet and lifestyle in maintain energy balance)
- b) Obesity and BMR; influencing factors
- c) Lethargy, tiredness, and restlessness; causative factors
- d) Hormones (introduction & examples; role of hormones in controlling growth & development; mood & behavior; metabolism)
- e) role of diet in anxiety and stress management

10

Unit III: Genetics

- a) Basic knowledge of hereditary, genes, DNA, Chromosomes, mutations, alleles.
- b) Basic rules of genetics (concept of inheritance, genetic variations, genomics, gene expression in-instructing message)
- c) Genes and Traits- (physical and physiological traits; genotype vs phenotype; polygenic traits; hereditary diseases)
- d) Genetic counselling (definition, and importance)
- e) Gene- environment interaction

10

List of Practical:

- 1. To test the presence of carbohydrates in food sample.

Handwritten signatures and marks:
P.P. Sharma
P.P. Sharma
P.P. Sharma