

DEPARTMENT OF BIOTECHNOLOGY

COURSE STRUCTURE & SYLLABI (For the students admitted from year 2023-2024 onwards)

Programme : B.Sc. Biotechnology



JAMAL MOHAMED COLLEGE (AUTONOMOUS)
Accredited with A++ Grade by NAAC (4th Cycle) with CGPA 3.69 out of 4.0
(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

B.Sc. BIOTECHNOLOGY

Sem	Course Code	Part	Course Category	Course Title	Ins. Hrs/Week	Credit	Marks		Total
							CIA	ESE	
I	23U1LT1/LA1/LF1/LH1/LU1	I	Language - I		6	3	25	75	100
	23UCN1LE1	II	English - I	English for Communication - I	6	3	25	75	100
	23UBT1CC1	III	Core - I	Fundamentals of Botany and Zoology	5	5	25	75	100
	23UBT1CC2P		Core - II	Fundamentals of Botany and Zoology - Practical	3	3	20	80	100
	23UBT1AC1		Allied - I	Biochemistry I : General Biochemistry	5	4	25	75	100
	23UBT1AC2P	III	Allied - II	Biochemistry I : General Biochemistry - Practical	3	2	20	80	100
	23UCN1AE1	IV	AECC - I	Value Education	2	2	-	100	100
Total					30	22			700
II	23U2LT2/LA2/LF2/LH2/LU2	I	Language - II		6	3	25	75	100
	23UCN2LE2	II	English - II	English for Communication - II	6	3	25	75	100
	23UBT2CC3	III	Core - III	Cell Biology	6	6	25	75	100
	23UBT2CC4P		Core - IV	Cell Biology - Practical	3	3	20	80	100
	23UBT2AC3		Allied - III	Biochemistry II: Bioenergetics and metabolism	4	4	25	75	100
	23UBT2AC4P	III	Allied - IV	Biochemistry II: Bioenergetics and metabolism - Practical	3	2	20	80	100
	23UCN2SS	IV	Soft Skills Development	Soft Skills Development	2	2	-	100	100
	23UCN2CO	V	Community Outreach	JAMCROP	-	@	-	-	@
23U2BT1 / 23U2AT1		Basic Tamil - I / Advanced Tamil - I	எழுத்தும் இலக்கியமும் அறிமுகம் - I / தமிழ் இலக்கியமும் வரலாறும் - I	-	-	-	100 #	-	
Total					30	23			700
III	23U3LT3/LA3/LF3/LH3/LU3	I	Language - III		6	3	25	75	100
	23UCN3LE3	II	English - III	English for Communication - III	6	3	25	75	100
	23UBT3CC5	III	Core - V	Genetics	4	4	25	75	100
	23UBT3CC6P		Core - VI	Genetics - Practical	3	3	20	80	100
	23UBT3AC5		Allied - V	Microbiology I: General Microbiology	4	4	25	75	100
	23UBT3AC6P	III	Allied - VI	Microbiology I: General Microbiology - Practical	3	2	20	80	100
	23UBT3GE1	IV	Generic Elective - I		2	2	-	100	100
	23UCN3AE2		AECC - II	Environmental Studies	2	2	-	100	100
Total					30	23			800
IV	23U4LT4/LA4/LF4/LH4/LU4	I	Language - IV		6	3	25	75	100
	23UCN4LE4	II	English - IV	English for Communication - IV	6	3	25	75	100
	23UBT4CC7	III	Core - VII	Molecular Biology	5	5	25	75	100
	23UBT4CC8P		Core - VIII	Molecular Biology - Practical	3	3	20	80	100
	23UBT4AC7		Allied - VII	Microbiology II: Applied Microbiology	5	4	25	75	100
	23UBT4AC8P	III	Allied - VIII	Microbiology II: Applied Microbiology - Practical	3	2	20	80	100
	23UBT4GE2	IV	Generic Elective - II		2	2	-	100	100
	23UCN4EL		Experiential Learning	Field Visit	-	2	-	100	100
	23UCN4EA	V	Extension Activities	NCC, NSS, etc.	-	1	-	-	-
23U4BT2 / 23U4AT2		Basic Tamil - II / Advanced Tamil - II	எழுத்தும் இலக்கியமும் அறிமுகம் - II / தமிழ் இலக்கியமும் வரலாறும் - II	-	-	-	100 #	-	
Total					30	25			800
V	23UBT5CC9	III	Core - IX	Plant Biotechnology	5	5	25	75	100
	23UBT5CC10		Core - X	Enzymology and Enzyme Technology	5	5	25	75	100
	23UBT5CC11		Core - XI	Immunology and Immunotechnology	5	5	25	75	100
	23UBT5CC12P	III	Core - XII	Plant Biotechnology, Enzymology and Enzyme Technology, Immunology and Immunotechnology - Practical	6	6	20	80	100
	23UBT5DE1A/B		Discipline Specific Elective - I		5	4	25	75	100
	23UBT5SE1	IV	Skill Enhancement Course - I	Evolution and Developmental Biology	2	1	-	100	100
	23UBT5SE2		Skill Enhancement Course - II	Industrial Fermentations	2	1	-	100	100
23UBT5EC1		Extra Credit Course - I*	Online Course	-	*	-	-	-	
Total					30	27			700
VI	23UBT6CC13	III	Core - XIII	Animal Biotechnology	5	5	25	75	100
	23UBT6CC14		Core - XIV	Environmental Biotechnology	6	6	25	75	100
	23UBT6CC15P		Core - XV	Animal Biotechnology and Environmental Biotechnology - Practical	6	6	20	80	100
	23UBT6PW		Project Work	Project Work	3	2	-	100	100
	23UBT6DE2A/B	III	Discipline Specific Elective - II		5	4	25	75	100
	23UBT6DE3A/B		Discipline Specific Elective - III		4	4	25	75	100
	23UCN6AE3	IV	AECC - III	Gender Studies	1	1	-	100	100
	23UBT6EC2		Extra Credit Course - II*	Online Course	-	*	-	-	-
23UBTECA		Extra Credit Course for all**	Online Course	-	**	-	-	-	
Total					30	28			700
Grand Total						148			4400

GENERIC ELECTIVE COURSES

Semester	Course Code	Course Title
III	23UBT3GE1	Edible Mushroom Cultivation Technology
IV	23UBT4GE2	Biofertilizer and Organic Farming

*** Self-Study Course – Basic and Advanced Tamil**

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Semester	Course Code	Course Title
II	23U2BT1	Basic Tamil – I (எழுத்தும் இலக்கியமும் அறிமுகம் - I)
	23U2AT1	Advanced Tamil – I (தமிழ் இலக்கியமும் வரலாறும் - I)
IV	23U4BT2	Basic Tamil – II (எழுத்தும் இலக்கியமும் அறிமுகம் - II)
	23U4AT2	Advanced Tamil – II (தமிழ் இலக்கியமும் வரலாறும் - II)

Mandatory

Basic Tamil Course - I and II are offered for the students who have not studied Tamil Language in their schools and college.

Advanced Tamil Course - I and II are offered for those who have studied Tamil Language in their schools but have opted for other languages under Part - I.

DISCIPLINE SPECIFIC ELECTIVES

Semester	Course Code	Course Title
V	23UBT5DE1A	Bioinformatics and Biostatistics
	23UBT5DE1B	Pharmacology and Nanomedicine
VI	23UBT6DE2A	Bioanalytical tools
	23UBT6DE2B	Plant and Animal physiology
	23UBT6DE3A	IPR, Biosafety and Bioethics
	23UBT6DE3B	Cancer and Stem Cell Biology

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBT1CC1	Core – I	5	5	25	75	100
Course Title		Fundamentals of Botany and Zoology					

SYLLABUS

Unit	Contents	Hours
I	Algae and Fungi: Algae - General characteristics and economic importance of algae, Algae life cycle (Oscillatoria, Chlorella, Oedogonium and Sargassum). Fungi -General characteristics of Fungi; *Economic importance of Fungi*. Fungal life cycle (Yeast, Plasmodiophora, Puccinia and Cercospora).	15
II	Bryophytes and Pteridophytes: Bryophytes - General characteristics and economic importance of Bryophytes, Bryophytes life cycle (Funaria and Usnea). Pteridophytes - General characteristics and economic importance of Pteridophytes, *Pteridophytes life cycle (Lycopodium and Marsilea)*.	15
III	Gymnosperms and Angiosperms: Gymnosperms - General characters and economic importance of Gynosperm (Cycas, Araucaria and Gnetum). Angiosperms - Taxonomy – Classification – Artificial (Linnaeus system) – Natural (Bentham and Hooker’s system). Binomial Nomenclature - *Herbarium Preparation*.	15
IV	Animal Diversity: Outline classification of kingdom Animalia; Study of invertebrates upto class level for Mollusca, Annelida, Echnodermata and Arthropoda. General classification and characteristics of vertebrates: Fishes, amphibians, Reptiles, Aves, *Mammals and minor phyla*.	15
V	Insect Diversity: Outline of classification of Insects, characters and types; Apis (Honeybee) – Bombyx (Silkworm) – Termites (White ants) – Lepidoptera (Butterfly) and Musca (House fly), Beetle (Rhinoceros), key pest of paddy. Economic importance of insects. *Integrated pest management (IPM)*.	15
VI	Current Trends (For CIA only): Bio-insecticide and Bio pesticides. Local field visit report and study.	

..... Self Study

Text Book(s):
1. John Merle Coulter, Charles Reid Barnes, Henry Chandler Cowles, A Textbook of Botany for Colleges and Universities: Morphology and physiology, Palala Press, 2018.
2. Cleveland Hickman, Susan Keen, David Eisenhower, Allan Larson, Integrated Principles of Zoology, Mc Graw Hill, 2019.
3. Stephen Miller Todd A. Tupper, Zoology, Mc Graw-Hill Education, 2018
Reference Book(s):
1. Dr. Kunal Sen, Dr. Pranab Giri, Fundamental Botany, Santra Publication, 2022.
2. T Jeffery Parker, William A Haswell, “A Text-Book of Zoology”, Vol 1, Alpha Edition, 2019.
3. Renuga Gupta, Fundamental of Zoology, Elite Publishing House, 1 st Edition, 2015.
Web Resource(s):
1. https://onlinecourses.nptel.ac.in/noc23_bt25/preview
2. https://onlinecourses.nptel.ac.in/noc20_bt42/preview
3. https://www.classcentral.com/course/swayam-basics-of-biology-58410

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Expand knowledge on the basic concepts of classification of algae and fungi.	K1
CO2	Classify and compare the evolutionary relationship of plants and animals.	K2
CO3	Examine and relate the fundamental knowledge about plants and their classification.	K3
CO4	Comprehend the basic concepts of animal science, classification and behaviour.	K4
CO5	Determine and appraise the conservation strategies for improvement of natural resources.	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	2	2	2	2.0
CO2	2	1	2	1	2	2	1	2	2	2	1.7
CO3	2	1	1	2	2	2	2	2	2	2	1.8
CO4	2	2	2	3	3	2	2	2	2	2	2.2
CO5	3	2	2	3	3	3	3	3	3	3	2.8
Mean Overall Score											2.1
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. J. Sebastin Raj

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBT1CC2P	Core- II	3	3	20	80	100

Course Title	Fundamentals of Botany and Zoology – Practical
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SYLLABUS

S.NO	Contents	Hours
1	Algae: Oscillatoria and Chlorella	45
2	Fungi: Yeast and Plasmodiophora	
3	Lichen: Funaria and Usnea	
4	Bryophytes: Marchantia and Anthoceros	
5	Pteridophytes: Lycopodium, Equisetum and Marsilea.	
6	Gymnosperms: Cycas and Gnetum.	
7	Angiosperm: Orchidaceae and Asteraceae	
8	Study of Vertebrates Specimens: Agnatha – Hagfishes (Jawless fish), Placodermi (Jawed fish), Chondrichthyes -(Sharks), Osteichthyes (Common carp), Amphibia (Salamander), Reptilia - (Turtle), Aves - (<i>Phoenicopterus</i>), Mammalia (<i>Platypus</i>)	
9	Study of Invertebrates Specimens: Leech, Peripatus, Daphnia, Millipede, Beetle, Octopus, Euglena, Noctiluca, Physalia, Taenia, Ascaris, Nereis.	
10	Dissections/ Virtual Demonstration: Mosquito Mouth Parts; Dissection of Frog	

Text Book(s):

1. John Merle Coulter, Charles Reid Barnes, Henry Chandler Cowles, A Textbook of Botany for Colleges and Universities: Morphology and physiology, Palala Press, 2018.
2. Cleveland Hickman, Susan Keen, David Eisenhower, Allan Larson, Integrated Principles of Zoology, Mc Graw Hill, 2019.
3. Stephen Miller Todd A. Tupper, Zoology, Mc Graw-Hill Education, 2018.

Reference Book(s):

1. Prashant Wagh, Botany Practical Handbook Paperback – February 10, 2019
2. Anand Dede, Handbook of Practical Zoology Paperback – November 5, 2020
3. Allaby, Michael.” The Concise Oxford dictionary of botany”, 1992.
4. M. Ingrowille, Diversity and Evolution of land plants, Chapman and Hall, 2012.
3. T Jeffery Parker, William A Haswell, “A Text-Book of Zoology”, Vol 1, 2012.

Web Resource(s):

1. <https://nptel.ac.in/courses/102104068/>
2. https://onlinecourses.nptel.ac.in/noc23_bt25/preview
3. <https://archive.nptel.ac.in/content/storage2/courses/122103039/pdf/mod1.pdf>

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Acquire basic knowledge on animal and plant organization.	K1
CO2	Describe the significance of evolutionary relationship of living organisms.	K2
CO3	Apply the knowledge of the concept of biodiversity and its advantages.	K3
CO4	Analyse the status of endangered flora and fauna.	K4
CO5	Assess the importance of biodiversity conservation through field visit to a botanical garden and zoological park.	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	1	2	3	2.0
CO2	2	2	2	1	2	2	2	2	2	1	1.8
CO3	2	2	2	2	2	2	2	2	3	3	2.2
CO4	3	2	2	2	3	2	2	2	3	3	2.4
CO5	3	2	1	3	3	2	1	2	3	3	2.3
Mean Overall Score											2.3
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. J. Sebastin Raj

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBT1AC1	Allied-I	5	4	25	75	100
Course Title		Biochemistry I: General Biochemistry					

SYLLABUS		
Unit	Contents	Hours
I	Chemical composition of life: Branches of Biochemistry, Origin & Chemical Composition of Life. Elements of Life- Atoms, Atomic number, atomic weight, Molecules, Chemical Compounds-Isotopes, Electrolytes & Non-Electrolytes. Hydrogen Ion concentration- pH Buffers, Colloids, Diffusion (Passive Transport)- *Osmosis- Surface Tension*.	15
II	Inorganic and organic compounds of Biomolecules: Historical Survey and Scope of Biochemistry. Inorganic and Organic compounds. Water, Acids, Bases, Salts, Gases, Minerals. Organic Compounds-classification of organic compounds, Major Characteristics of Biomolecules, Carbon as the Main Component of Biomolecules, *Carbon, the backbone of Organic Compounds*. Functional groups of Biomolecules.	15
III	pH and buffer system: Definition, principle and theories of pH, p ^H meter, pH Measurement, Uses of pH meter, pH of Biological Fluids and Tissues, Hydrogen ion concentration, Importance of pH and pH regulations. Buffer system-Definition, mechanism of buffer action, Bicarbonate, Phosphate, Haemoglobin and Protein buffer system, *Significance of Buffers*.	15
IV	Redox reaction: Redox reaction-Introduction, oxidation, reduction, oxidizing agent, reducing agent, redox reaction, and redox potential. Theories of biological oxidation-Oxygen activation theory, Hydrogen activation theory, Hydrogen acceptors and carriers-Nicotinamide nucleotides, *Flavin nucleotides and the cytochromes*.	15
V	Applications of Biochemistry: Application of Biochemistry in Agriculture biochemical fertilizers, Medicine - Importance of Enzymes in Medicines, Nutrition-Food Metabolomics, Applications of Biochemistry in Biotechnology, Pharmacology, Microbiology and Environmental Health, aquaculture, *textile industry and poultry*.	15
VI	Current Trends (For CIA only) – Discovery of novel biomolecule – glycol RNA	

..... Self Study

Text Book(s):
1. Harper's, Illustrated Biochemistry, Victor W. Rodwell , David Bender , Kathleen M. Botham , Peter J. Kennelly , P. Anthony Weil , 31 st Edition, 2018.
2. D. Voet and J.G. Voet, “Biochemistry”, John Wiley & Son, 4 th Edition, 2021.
3. Lehninger, Principles of Biochemistry, Nelson & Cox, Macmillan Worth Publishers, 8 th edition 2021.

Reference Book(s):

1. Robert Haeper's, Biochemistry, Mc Graw Hill, 32nd edition, 2022.
2. Donald Voet, J.G.Voet, John Wiley, Biochemistry, Stryer W.H Freeman. John Wiley P & Publisher Kaye Pace, 8th edition, 2023.
3. A.L.Jain, Essentials of Biochemistrty, S. Chand publications, 7th edition, 2016.

Web Resource(s):

- 1.https://nptel.ac.in/content/syallabus_pdf/104105040.pdf
- 2.<https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes>
3. <https://nptel.ac.in/courses/104103121>

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the scope of biochemistry	K1
CO2	Illustrate the chemical composition of life	K2
CO3	Identify the inorganic and organic compounds of Biomolecules	K3
CO4	Examine the pH and buffer system of human body	K4
CO5	Evaluate the applications of Biochemistry in various fields	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	1	1	2	3	2.4
CO2	3	1	2	1	3	2	1	1	2	1	1.7
CO3	3	1	1	2	3	2	2	2	3	3	2.2
CO4	3	1	1	2	3	2	2	2	3	3	2.2
CO5	3	1	1	3	3	2	1	2	3	3	2.2
Mean Overall Score											2.14
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. T. Nargis Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBT1AC2P	Allied-II	3	2	20	80	100
Course Title		Biochemistry I: General Biochemistry - Practical					

SYLLABUS		
S.NO	Contents	Hours
1	General guidelines and laboratory safety measure for working in Biochemistry laboratory	45
2	Units of volume, weight and concentration, measurements and their range in biological measurements	
3	Verification of beer-Lambert's law using colorimeter	
4	Determination of concentration of potassium Dichromate solution	
5	Determination of complementary colours	
6	Determination of pH of acid /base using pH meter	
7	Preparation of percentage solution	
8	Preparation of Normality and Molarity solution	
9	Preparation of phosphate and acetate buffer	
10	Preparation of Tris-Hcl buffer	

Text Book(s):
1. Dr. J. Jayaraman, Manuals in Biochemistry, New Age International Pub, Bangalore, 1 st edition, 2011. 2. Dr. S. Sadasivam & A manickam, Biochemical Methods, 3 rd edition, 2018 2. Plummer, Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company, 3 rd edition, 2017. 3. Dr. G. Sattanathan, Dr. S.S. Padmapriya, Dr. B. Balamurali Krishnan, Practical Manual of Biochemistry, Skyfox Publishing Group Skyfox Press, 1 st edition, 2020.
Reference Book(s):
1. S.Sadasivam,V.A Manickam , Biochemical methods - New Age International Publishers, 3 rd edition, 2018. 2. Anil Kumar, Sarika Garg and Neha Garg, Biochemical Tests- Principles and Protocols. Vinod Vasishtha Viva Books Pvt Ltd, 2 st edition, 2017. 3. Prem Prakash Gupta, Neelu Gupta, Essentials of Practical Biochemistry, Jaypee Publishers, 1 st edition, 2017.
Web Resource(s):
1. https://nptel.ac.in/content/storage2/courses/102103044/module/lec1/1.htm 2. https://nptel.ac.in/content/storage2/coureses/102103047/pdf/modl.pdf 3. https://archive.nptel.ac.in/courses/104/105/104105102/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the general guidelines and laboratory safety measure for working in biochemistry laboratory	K1
CO2	Understand the principles of colorimeter	K2
CO3	Apply the laboratory safety measures for working in Biochemistry laboratory	K3
CO4	Analyze the preparation and standardization of various solutions	K4
CO5	Assess the techniques to evaluate biomolecules in human sample	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	2	1	2	3	2.5
CO2	3	2	2	1	3	2	2	2	2	1	2.0
CO3	3	2	2	2	3	2	2	2	3	3	2.4
CO4	3	2	2	2	3	2	2	2	3	3	2.4
CO5	3	2	1	3	3	2	1	2	3	3	2.3
Mean Overall Score											2.32
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. T. Nargis Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UCN1AE1	AECC - I	2	2	-	100	100
Course Title		Value Education for Women					

SYLLABUS		
Unit	Contents	Hours
I	VALUES IN LIFE: Purpose and philosophy of life – Need for values –five fold moral culture - Imbibing values: truth, loyalty, integrity, humility, trustworthy, considerate, not being greedy, clean habits, punctuality, kindness, gratitude, patience, respect and character building.	6
II	FAMILY: Nuclear – cluster – significance - social functions - changing trend - role of women in family - obedient daughter - purposeful youth- dedicated wife - caring mother.	6
III	PUBERTY: Need of knowledge of menstruation- menstrual symptoms – handling – menstrual disorder - maintaining good personal hygiene - motherhood- Stages of pregnancy- post pregnancy care.	6
IV	MARRIAGE: Types of marriage - purpose of marriage- love and infatuation – need for marital preparation - pre and post marital counselling - conflicts in marital life - divorce single parenthood.	6
V	HARMONY WITH SPOUSE: Husband and wife relationship - fidelity towards spouse-relationship among the family members. Tenets of bride for healthy family – kindness, respect, patience, care, love.	6

Hours of Teaching: 5 hours and Hours of Activity: 25 hours

Textbook(s):
1. Value Education for health, Happiness and harmony, the world community service centre, Vethathri Publications 2. N. Venkataiah, Value Education, APH Publishing Corporation, New Delhi, 1998 3. Betty, Carten and Meg Goldric, The Changing family life style - A Framework for Family Therapy, 2 nd Edition, 2000. 4. Marie, Madearentas, Family Life Education, CREST-Centre for research education service training for family promotion, Bangalore, 1999.
Web References:
1. https://www.slideshare.net/humandakakayilongranger/values-education-35866000 2. https://www.ananda.org/blog/5-secrets-to-a-harmonious-marriage/ 3. https://www.nap.edu/read/2225/chapter/14

Activity:

- Assignment on Values (not less than 20 Pages)
- Multiple Choice Questions and Quiz
- Elocution - (Manners and good Habits for 3 to 5 minutes)
- Field Visit
- Debating - Current issues
- Essay writing: Proper use of e-gadgets, Ethics, Cyber ethics, Social media, etc.,
- Case Study / Album Making / Poster Presentation / Documentary- Celebrating National Days, Drug abuse & illicit trafficking, Independence Day, Secularism, Teachers Day, National Youth Awakening Day, Father's Day / Mother's Day and etc.,

EVALUATION COMPONENT: TOTAL: 100 MARKS**Component I:**

Documentary (or) Poster Presentation (or) Elocution - 25 marks

Component II:

Quiz (or) Multiple choice questions Test - 25 marks

Component III:

Album Making (or) Case Study on a topic (or) Field visit - 25 marks

Component IV:

Assignment (or) Essay Writing (or) Debating - 25 marks

Course Coordinator: Dr. M. Purushothaman

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UBT2CC3	Core – III	6	6	25	75	100
Course Title		Cell Biology					

SYLLABUS		
Unit	Contents	Hours
I	Fundamentals of cell biology, cell cycle and cell division: History and Discovery of cells, physiological properties of cells, Cell theory, cell biology in 20 th century. Different class of cells, Prokaryotic and Eukaryotic Cells, Virus cells, Cell cycle and its regulation; Cell division: mitosis; meiosis, binary fission,*Cell death – Apoptosis and Aging*.	18
II	Cellular membranes, matrices and cytoskeleton: Trilaminar model, lattice model, fluid mosaic model, Micellar model, chemical composition of membranes; specialization of plasma membrane, function of cell membrane- active and passive transport, extracellular matrices – structure and function; Cytoskeleton – structure and function of microtubules, microfilaments.*Cytoskeletal architecture*.	18
III	Cellular organelles and its function: Structure and functions of cytoplasm, ribosomes, endoplasmic reticulum – smooth & rough; golgi complex, Lysosomes, peroxisomes, centrosome, vacuoles, microbodies, Mitochondria – structure and function; plastids, chloroplast – structure and function.*Cell locomotion - cilia and flagella*	18
IV	Nucleus and Chromosomes: Introduction, Structure of the interphase nucleus and function of Nucleus, chemistry of the nucleus and nucleolus; chromosome - structure and function, *Special type of chromosome*.	18
V	Tools and techniques in cell biology: Microtome, cytochemical staining of cells and tissues, micrometry, Microscopy –Bright field, Dark field, Phase contrast Microscopy – Fluorescent Microscope, Electron microscopy - Scanning Electron Microscope, Atomic Force Microscope.	18
VI	Current Trends (For CIA only) – Cryomicrotomy	

..... Self Study

Text Book(s):
1. Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell, Molecular Cell Biology, W.H. Freeman and Company, 9 th edition, 2021.
2. N.Arumugam, Cell Biology, SARAS Publication, 5 rd edition, 2017.
3. Aruna Sarangi, Principles of Cell Biology, Pacific Publication, Delhi, 5 rd edition, 2010.
Reference Book(s):
1. T. A. Brown, Introduction to genetics: A molecular approach Garland Science, 2 nd Edition. 2016.
2. J. D. Watson Tania, A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. Molecular Biology of the Gene. Benjamin/Cummings Publ. Co., Inc., 7th Edition, 2015.
3. Benjamin Lewin. Genes XI. Jones & Bartlett Learning, 9th Edition, 2011.
Web Resource(s):
1. https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/
2. https://swayam.gov.in/nd1_noc20_me04/preview
3. https://cellbiology.med.unsw.edu.au

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the basic concepts of cell biology and properties of cells.	K1
CO2	Summarize the cell cycle, Cellular membranes and matrices.	K2
CO3	Identify the sub cellular organelles and describing their structure and functions.	K3
CO4	Analyze and interpret the behaviour of cells in their microenvironment in multi-cellular organisms with emphasis on cell-cell interactions.	K4
CO5	Evaluate the chemical and molecular processes that occur inside cells.	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	2	3	2	2	3	3	2.5
CO2	3	2	2	2	3	2	3	2	2	2	2.3
CO3	3	3	1	1	2	3	1	1	2	1	1.8
CO4	3	3	2	2	3	2	3	1	2	2	2.3
CO5	3	3	2	1	3	2	1	2	2	3	2.2
Mean Overall Score											2.2
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Deborah

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UBT2CC4P	CORE – IV	3	3	20	80	100
Course Title		Cell Biology - Practical					

SYLLABUS		
S.No.	Contents	Hours
1	Microscopy–Observation of a typical plant (onion peel) and animal cell (Cheek cells with a cotton swab) by Simple and compound microscope	45
2	Measurement of cells using ocular and stage micrometer	
3	Study of structure of cell: Structure observation of Prokaryotic and Eukaryotic cell	
4	Analysis of transverse sections of stem, root and leaf for Parenchyma, Collenchyma and Sclerenchyma cells	
5	Total cell count of WBC and RBC	
6	Differential count of WBC and RBC	
7	Cell Staining and Cytochemical methods-Demonstration of Cellular and sub-cellular	
8	Staining of fresh tissues like Squamous Epithelium/ Ciliated Epithelium	
9	Experiment on Haemin Crystals.	
10	Cell division: Study of different stages of meiosis by temporary / permanent preparation	
11	Cell division: Study of different stages of mitosis by temporary / permanent preparation	
12	Cell division: Binary fission of yeast	

Text Book(s):
1. Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. Molecular Cell Biology, W.H. Freeman and Company, 9 th edition, 2021.
2. N. Arumugam, Cell Biology, SARAS Publication, 5 rd edition, 2017.
3. Aruna Sarangi, Principles of Cell Biology, Pacific Publication, Delhi, 5 rd edition, 2010.
4. KARA WEBER, CYTOLOGY March 13, 2023.
5. Bal Ram Singh and Raj Kumar Practical Techniques in Molecular Biotechnology, Jul 28, 2022
Reference Book(s):
1. P.Gunasekaran. Laboratory Manual in Microbiology.2nd edition, New Age International, 2007.
2. Zsolt Fazekas, Cell Biology Laboratory Manual, 8th edition, university press, 2011.
Web Resource(s):
1. https://www.youtube.com/watch?v=wMgXsrpVrJg
2. https://www.youtube.com/watch?v=k1O9jBHgsxs
3. https://www.youtube.com/watch?v=5V52RzM84TM

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the terms WBC and RBC	K1
CO2	Understand the working principle of Microscopy	K2
CO3	Identify the structure of cells using microscopy and other analytical techniques.	K3
CO4	Discover their skills in the preparation and identification of cell structures and their functions using staining techniques.	K4
CO5	Deduct the Cytochemical methods	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	2	3	3	2.8
CO2	3	2	2	2	3	2	3	2	2	2	2.3
CO3	3	2	2	2	3	3	1	1	2	1	2.0
CO4	3	3	2	2	3	2	3	1	2	2	2.3
CO5	3	3	2	1	3	2	1	2	2	3	2.2
Mean Overall Score											2.32
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Deborah

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UBT2AC3	Allied - III	4	4	25	75	100

Course Title	Biochemistry II: Bioenergetics and metabolism
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SYLLABUS

Unit	Contents	Hours
I	Bioenergetics: Free energy and entropy changes in biological system, coupling of endergonic and exergonic processes. High energy phosphate compounds -Structure and importance of ATP. Biological oxidation-Enzymes involved in oxidation and reduction- oxidases, dehydrogenases, *Hydro peroxidase and oxygenases*.	12
II	Mechanism of oxidative phosphorylation: Introduction of Electron transport chain Components of ETC, Inhibitors of ETC, Oxidative phosphorylation uncouplers, inhibitors, ionophores. *Chemiosmotic theory*.	12
III	Carbohydrates metabolism: Introduction, classification of carbohydrates - Monosaccharides, Disaccharides and polysaccharides, Biological functions of carbohydrates. Glycolysis and its energetic, s, oxidation of pyruvate to acetyl CoA, TCA cycle and its energetic, *glycogenesis and glycogenolysis*.	12
IV	Lipid metabolism: Introduction, classification of lipids-simple, compound and derived lipids. Biosynthesis of fatty acids,β Oxidation of fatty acids, plasma lipoproteins, *Biological importance of lipids*.	12
V	Amino acids and Nucleic acid metabolism: Classification of amino acids, catabolism of amino acids - Deamination, decarboxylation, transamination - Glycogenic and ketogenic amino acids, urea-biosynthesis. *Structure of protein*, Metabolism of purine and pyrimidine nucleotides.	12
VI	Current Trends (For CIA only) – Metabolism Research in the fields of diabetes and obesity, Uric acid as an antioxidant.	

..... Self Study

Text Book(s):
<ol style="list-style-type: none"> 1. Harper's, Illustrated Biochemistry, Victor W. Rodwell , David Bender , Kathleen M. Botham , Peter J. Kennelly , P. Anthony Weil, 31stEdition, 2018. 2. D. Voet and J.G. Voet, “Biochemistry”, John Wiley & Son,4thEdition, 2021. 3. Lehninger, Principles of Biochemistry, Nelson& Cox, Macmillan Worth Publishers,8th edition 2021.
Reference Book(s):
<ol style="list-style-type: none"> 1. Robert Haeper’s, Biochemistry, Mc Graw Hill, 32nd edition, 2022. 2. Donald Voet, J.G.Voet, John Wiley, Biochemistry, Stryer W.H Freeman. John Wiley P & Publisher Kaye Pace, 8th edition, 2023. 3. J.L.Jain, Essentials of Biochemistrty, S. Chand publications, 7th edition, 2016.
Web Resource(s):
<ol style="list-style-type: none"> 1. https://nptel.ac.in/content/syallabus_pdf/104105040.pdf 2. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/week-1_06-Carbo.pdf 3. https://archive.nptel.ac.in/content/storage2/courses/104103071/pdf/mod12.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the terms involved in Bioenergetics	K1
CO2	Understand the mechanism of oxidative phosphorylation	K2
CO3	Construct the energy transformation in living system	K3
CO4	Examine the metabolism of carbohydrates	K4
CO5	Examine the adequate exposure in aminoacid and nucleic acid metabolism	K5

Relationship Matrix:

Course Outcome s (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	3	3	3	3	3	3	1	1	2	3	2.5
CO2	3	0	2	0	3	2	0	1	2	1	1.4
CO3	3	1	1	3	3	2	2	3	3	3	2.4
CO4	3	1	1	3	3	2	2	2	3	3	2.3
CO5	3	1	1	3	3	2	1	2	3	3	2.2
Mean Overall Score											2.16
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. T. Nargis Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UBT2AC4P	Allied - IV	3	2	20	80	100

Course Title	Biochemistry II: Bioenergetics and Metabolism - Practical
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SYLLABUS		
S.NO	Contents	Hours
1	Qualitative tests for carbohydrates	45
2	Qualitative analysis of amino acids	
3	Paper and thin layer chromatography (separation of amino acids)	
4	Column chromatography	
5	Preparation of starch from potato	
6	Preparation of casein from milk	
7	Preparation of albumin from egg	
8	Estimation of reducing sugar by DNS method	
9	Estimation of protein by Lowry's method	
10	Estimation of amino acid by Ninhydrin method	

Text Book(s):
<p>1. Dr. S. Sadasivam & A manickam, Biochemical Methods, 3rd edition, 2018</p> <p>2. Plummer, Practical Biochemistry, New Delhi: Tata Mcgraw Hill Publishing Company, 3rd edition, 2017.</p> <p>3. Dr. G. Sattanathan, Dr. S.S. Padmapriya, Dr. B. Balamurali Krishnan, Practical Manual of Biochemistry, Skyfox Publishing Group Skyfox Press, 1st edition, 2020.</p>
Reference Book(s):
<p>1. S.S adasivam, V.A Manickam , Biochemical methods - New Age International Publishers, 3rd edition, 2018.</p> <p>2. Anil Kumar, Sarika Garg and Neha Garg, Biochemical Tests- Principles and Protocols. Vinod Vasishtha Viva Books Pvt Ltd, 2st edition, 2017.</p> <p>3. Prem Prakash Gupta, Neelu Gupta, Essentials of Practical Biochemistry, Jaypee Publishers, 1st edition, 2017.</p>
<p>1. https://nptel.ac.in/content/storage2/courses/102103044/module/lec1/1.htm</p> <p>2. https://nptel.ac.in/content/storage2/coureses/102103047/pdf/modl.pdf</p> <p>3. https://archive.nptel.ac.in/courses/104/105/104105102/</p>

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Remember the basic terms involved in separation and purification techniques.	K1
CO2	Understand the working principles of TLC and Column chromatography	K2
CO3	Experiment with the qualitative analysis of carbohydrates, aminoacids and lipids.	K3
CO4	Analyze and isolate amino acid using chromatographic techniques.	K4
CO5	Estimate the carbohydrate, protein and amino acids in different food samples	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	2	1	2	3	2.5
CO2	3	2	2	1	3	2	2	2	2	1	2.0
CO3	3	2	2	2	3	2	2	2	3	3	2.4
CO4	3	2	2	2	3	2	2	2	3	3	2.4
CO5	3	2	1	3	3	2	1	2	3	3	2.3
Mean Overall Score											2.3
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. T. Nargis Begum

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UCN2SS	Soft Skills Development	2	2	-	100	100
Course Title		Soft Skills Development					

SYLLABUS		
Unit	Contents	Hours
I	Communication Skills: Verbal and Non - Verbal communication - The active vocabulary - Conversational Etiquette - KOPPACT syndrome	6
II	Emotional Skills: Emotional Intelligence - The five steps to Emotional Quotient - Self Awareness and Regulation - Empathy - Social Intelligence - stress management - coping with failures	6
III	Functional Skills: Using the tools of communicatory and emotional skills - Resume writing - Preparation of Curriculum Vitae - interview skills - Acing the interview - Group dynamics - Mock interviews and Group discussions	6
IV	Interpersonal Skills: Synergising relationships - SWOT analysis - SOAR analysis - The social skills - Time Management - Decision making - problem solving - prioritising and Implementation	6
V	Personality Skills: Leadership skills - Attributes and Attitudes - Social leader Vs The Boss - critical and creative thinking	6

Hours of Teaching : 5 hours and Hours of Activity: 25 hours

Textbook(s):
<ol style="list-style-type: none"> 1. Social intelligence: The new science of human relationships - Daniel Goleman; 2006. 2. Body Language in the workplace - Allan and Barbara Pease; 2011. 3. Student's Hand Book: Skill Genie - Higher education department, Government of Andhra Pradesh.
Web References:
<ol style="list-style-type: none"> 1. https://nptel.ac.in/courses/109105110

EVALUATION CRITERIA

Work Book (Each unit carries 10 marks)	-	50 Marks
Examination	-	50 Marks

1. Teacher who handles the subject will award 50 marks for work book based on the performance of the student.
2. On the day of examination the examiners (Internal & External) will jointly award the marks for the following categories:
 - Self-Introduction - 20 Marks
 - Resume - 10 Marks
 - Mock Interview - 20 Marks

To assess the self-introduction, Examiners are advised to watch the video presentation submitted by the students. If they failed to submit the video presentation, the Examiners may direct the student to introduce himself orally and a maximum 10 marks only will be awarded.

Mock Interview Marks Distribution

(20-Marks)

Attitude (self interest, confidence etc.) (4 Marks)	Physical appearance including dress code (4 Marks)	Communication Skills (6 Marks)	Answering questions asked from the resume and work book (6 Marks)
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Course Coordinator:
Dr. M. Syed Ali Padusha

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBT3CC5	Core – V	4	4	25	75	100
Course Title		GENETICS					

SYLLABUS		
UNIT	CONTENTS	HOURS
I	Introduction to Genetics: Introduction and brief history of genetics -Mendel's Law of inheritance - Mono and Dihybrid cross, Tri and Poly hybrid crosses, Incomplete dominance, Back cross, Test cross, Phenotype and Genotype; Interaction of Genes– Complementary factors, supplementary factors, inhibitory and lethal factors, *Multiple Alleles in <i>Drosophila</i> *.	12
II	Experimental evidence for DNA as the genetic material: Chromosome organization, fine structure of gene, structure of Prokaryotic and Eukaryotic gene, maternal inheritance - cytoplasmic genetic systems- mitochondria and chloroplast DNA, genetics of bacteria and viruses- conjugation, transduction, transformation *bacterial viruses*	12
III	Linkage and Crossing Over: Introduction, Coupling and repulsion hypothesis, Linkage in maize and <i>Drosophila</i> – Morgan's experiments, theories of linkage, factors affecting linkage, Mechanism of crossing over and its importance. Types, and mechanisms, Cytological evidence for crossing over and significance. *Sex determination in plants and animals*.	12
IV	Transposon and transposable elements: IS elements, composite transposons- Tn5- Tn9- Tn10 elements- eukaryotes, Ac and Ds elements in mice, P elements in <i>Drosophila</i> . *Genetic and evolutionary significance of transposable elements*.	12
V	Human Genetics: Karyotype in man, inherited disorders – Allosomal (Klinefelter syndrome and Turner's syndrome) and Autosomal (Down syndrome and Cri-Du-Chat Syndrome). Population genetics: Single and multi-locus inheritance and Hardy-Weinberg principle, genetic drift and natural selection. *Mutations in plants, animals and microbes for economic benefit of man.*	12
VI	Current Trends (For CIA only): Molecular diagnostics of hereditary metabolic disorders, mitochondrial mutations that lead to cancer	

..... Self-study

Text Books:
1. T.A. Brown, Genetics. A Molecular Approach, Chapman Hall, London, 2010.
2. E.J. Gardner, M.J. Simmons, and D.P. Snusted. Principles of Genetics, John Wiley and Sons, New York, 2001.
3. J.W. Saunders. Developmental Biology – Patterns and Principles, Macmillan, New York, 2005.
Books for Reference:
1. M.W. Strick Berger. Genetics, Macmillan publishing Co., New York, 2008.
2. P.S. Verma and V.K. Agarwal. Genetics, S. Chand & Company Ltd, New Delhi, 2003.
3. R.F. Weaver and, P.W. Hedrick. Genetics, W.M.C. Brown Publishers, London, 2005.
4. P.Hotter. Textbook of Genetics, IVY Publishing House, New Delhi, 2002.
5. W.S. Klug, M.R. Cummings, C.A. Spencer and M.A. Palladino. Concepts of Genetics, 10 th Edition, Pearson International Publishers, 2015.

Web Source:

1. <https://nptel.ac.in/courses/102/104/102104052/>
2. https://swayam.gov.in/nd1_noc20_bt06/preview
3. https://swayam.gov.in/nd2_cec20_bt06/preview

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO NO.	CO Statement	Cognitive Level (K-Level)
CO1	Illustrate the basic knowledge in genetics and Mendelian theory	K3
CO2	Analyse evidence for DNA as a genetic material	K4
CO3	Explain about the linkage and crossing over in genetics studies of living organisms.	K5
CO4	Develop skills associated with transposons and transposable elements	K5
CO5	Explain about Human Genetics and its inherited disorders	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	2	3	3	2	3	3	3	2.8
CO2	3	2	3	2	2	2	2	2	3	2	2.3
CO3	2	3	2	3	3	2	2	3	3	2	2.5
CO4	2	3	2	3	2	2	2	3	2	3	2.4
CO5	3	3	2	3	2	3	2	2	3	2	2.5
Mean Overall Score											2.5
Correlation											High

Mean Overall Score	Correlation
<1.5	Low
>-1.5 and <2.5	Medium
>-2.5	High

Course Coordinator: Dr. R. Shalini

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBT3CC6P	Core – VI	3	2	80	20	100
Course Title		GENETICS – PRACTICAL					

SYLLABUS		
S. No	Contents	Hours
1.	Watson and Crick double helical DNA model.	45
2.	Linkage Mapping	
3.	Use of micrometer and calibration	
4.	Study of divisional stages in mitosis from onion root tips	
5.	Study of divisional stages in meiosis in grasshopper testes/or Rhoeo flower buds.	
6.	Karyotype analysis - Human and Onion	
7.	Experiments to determine Mendel's law.	
8.	Extraction of human genomic DNA from saliva.	
9.	Human Karyotypes: Normal, Down's, Klinefelters and Turner's syndrome.	
10.	Sex chromatin (buccal smear) identification.	
11.	Isolation and display of polytene chromosomes	

Text Books:

1. T.A. Brown, Genetics. A Molecular Approach, Chapman Hall, London, 2005.
2. E.J. Gardner, M.J. Simmons, and D.P. Snusted. Principles of Genetics, John Wiley and Sons, New York, 2005.
3. J.W. Saunders. Developmental Biology – Patterns and Principles, Macmillan, New York, 2001.

Books for Reference:

1. M.W. Strickberger. Genetics, Macmillan publishing Co., New York, 2008.
2. P.S. Verma and V.K. Agarwal. Genetics, S. Chand & Company Ltd, New Delhi, 2003.
3. R.F. Weaver and, P.W. Hedrick. Genetics, W.M.C. Brown Publishers, London, 2001.
4. Weaver R.F. and Hedrick PW. Genetics, 3rd Edition, W.M.C. Brown Publishers, London, 2004.
5. P. Hotter. Textbook of Genetics, IVY Publishing House, New Delhi, 2002.
6. W.S. Klug, M.R. Cummings, C.A. Spencer and M.A. Palladino. Concepts of Genetics, 9th Edition, Pearson International Publishers, 2009.

Web Source:

1. <https://nptel.ac.in/courses/102/104/102104052/>
2. https://swayam.gov.in/nd2_cec20_bt17/preview

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO NO.	CO Statement	Cognitive Level (K-Level)
CO1	Acquire knowledge about the tools used for genetic analysis -Micro-meter calibration.	K2
CO2	Explicate about the detailed processes of cell division.	K4
CO3	Illustrate Mendel's Law through practical experiments.	K4
CO4	Explore the techniques for isolation of human genomic DNA from saliva.	K5
CO5	Expertise in techniques for Sex chromatin identification from buccal smear and use in various applications.	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	2	3	3	2	3	3	3	2.8
CO2	3	2	3	2	2	2	2	2	3	2	2.3
CO3	2	3	2	3	3	2	2	3	3	2	2.5
CO4	2	3	2	3	2	2	2	3	2	3	2.4
CO5	3	3	2	3	2	3	2	2	3	2	2.5
Mean Overall Score											2.5
Correlation											High

Mean Overall Score	Correlation
<1.5	Low
>-1.5 and <2.5	Medium
>-2.5	High

Course Coordinator: Dr. R. Shalini

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBT3AC5	Allied – V	4	4	25	75	100
Course Title		Microbiology I: General Microbiology					

SYLLABUS		
Unit	Contents	Hours
I	History and Classification: History of Microbiology, Concepts of Domain: Haeckel's three kingdom, * Whittaker's five kingdom*, Cavalier-Smith's six kingdom and outline of Bergey's Manual of Systematic Bacteriology. Early development of Virology, Nomenclature and Taxonomy of Eukaryotic viruses, Principles of virus taxonomy. Classification of Fungi (Alexopoulos).	12
II	Structure and Organization: Overview of Prokaryotic & Eukaryotic cell structure - Inclusion bodies – Endospores - Cell wall – Flagella & Pili – Glycocalyx. General properties of viruses, Structure of viruses, Capsids, Viruses with capsids of complex symmetry, viral envelopes, Classification of Bacterial and Archaeal viruses.	12
III	Cultivation of Bacteria and Virus: Basic sterilization techniques- wet heat (autoclaving), dry heat- flaming, baking, filtration, disinfection and radiation, gas sterilization. Macronutrients and micronutrients, nutritional types of microorganisms and growth factors. Culture media - chemical and physical types; functional types; *Isolation of pure culture*; Growth curve and Mathematics of Growth; Measurement of microbial growth – cell number and cell mass. Factors affecting growth. Cultivation of viruses, Virus purification and assays.	12
IV	Bacterial / Viral Detection & Antimicrobial agents: Staining techniques: Antimicrobial Susceptibility Testing – Kirby-Bauer method, Multidrug-resistant organisms. Viral Serological assay, Nucleic Acid Amplification Tests (NAATs), and Immunofluorescence Assay. *Antibacterial drug: penicillin and cephalosporin*. Antiviral drug: Acyclovir and Tamiflu. Antimicrobial chemotherapy – Tests for sensitivity to antimicrobial agents. Acid-Fast Staining, Capsule Staining and Flagella Staining,	12
V	Disease and Treatment: Airborne diseases – Bacterial diseases- Diphtheria and Mycobacterium tuberculosis; Food-borne and waterborne diseases – Typhoid Fever, Staphylococcal Food Poisoning, Cholera and Botulism; Viral diseases- Influenza (Flu), AIDS; Viroids and virusoids; prion diseases. *Control of Microorganisms*	12
VI	Current Trends (For CIA only): Dimethyl sulfonic propionate and its catabolites are important chemical signals mediating marine microbial interactions.	

*.....*Self Study

Text Book(s):
1. M. Joanne, Willey, M. Linda, Sherwood and J. Christopher, Woolverton, Prescott, Harley, and Klein's Microbiology, 7 th edition, McGraw Hill, Colin Wheatley/Janice Roerig-Blong, 2008.
2. Stuart Hogg, Essential Microbiology, John Wiley & Sons, Ltd, 2005.
3. Uma Shankar Singh and Kiran Kapoor, Microbial Biotechnology, Oxford Book Company, 2010

Reference Book(s):
4.J.M. Pelczar, E.C.S. Chan, and N.R. Krieg, Microbiology, 5 th Edition Tata McGraw Hill Publishing Company, 2006.
5.R. Anantha Narayanan and C.K.J. Panikar, 6 th Edition, General Microbiology, Orient Longman Pvt. Ltd., 2002.
Web Resource(s):
1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1182391/ *
2. https://nptel.ac.in/courses/102103015/ *
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6428495/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Develop an understanding on the different aspects of Bacteria, fungi, Virus and its history.	K2
CO2	Relate, identify and discriminate among Prokaryotic and Eukaryotic organisms.	K4
CO3	Classify the properties, structure and cultivation of Bacteria and Virus.	K5
CO4	Gain expertise in the handling of bacteria and viruses and detecting their presence through various tests.	K5
CO5	Examine the different aspects of viral, bacterial diseases and research findings in the areas of Bioinformatics in microbial technology	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcome (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	2	2	2	2.0
CO2	2	1	2	1	2	2	1	2	2	2	1.7
CO3	2	1	1	2	2	2	2	2	2	2	1.8
CO4	2	2	2	3	3	2	2	2	2	2	2.2
CO5	3	2	2	3	3	3	3	3	3	3	2.8
Mean Overall Score											2.1
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: M .Habibunisha

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBT3AC6P	Allied – VI	3	2	20	80	100
Course Title		Microbiology I: General Microbiology – Practical					

SYLLABUS		
S.No	Contents	Hours
1	Basic Sterilization techniques used in the Microbiology lab.	45
2	Media preparation: Liquid media, Solid media, Agar slants, Agar Plates.	
3	Cultural characteristics of microorganisms: Growth on different media, growth characteristics and description	
4	Isolation & Enumeration of Microorganism from air.	
5	Isolation & Enumeration of Microorganism from water and soil.	
6	Pure culture techniques - Pour plate; Spread plate, Streak plate.	
7	Staining Techniques – Gram’s staining, Negative staining, Spore’s staining	
8	Motility - Hanging drop method	
9	Biochemical characterization of microorganisms – carbohydrate utilization and IMViC tests, catalase and oxidase test.	
10	Measurement of Growth – Spectrophotometry	
11	Isolation of Bacteriophage (that infect <i>E. coli</i>) from sewage.	
12	Quantitation of phage in sewage sample by phage plaque Assay.	
13	Demonstration of mechanical transfer of viruses in plants by sap inoculation.	
14	Study of virus infected plant samples.	
Text Book(s):		
1. Cappuccino and Sherman. Microbiology – A Laboratory Manual. 7th Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi. 2012.		
2. P. Gunasekaran, Laboratory Manual in Microbiology, New Age International (P) Ltd. Publishers, New Delhi. 2008.		
Reference Book(s):		
1. 1. W. Harry, J.R. Seeley, J. Paul, Van Demark and John J Lee, Microbes in Action – A Laboratory Manual of Microbiology. W.H.Freeman and Company, New York. 1997.		
2. Kanika Sharma. Manual of Microbiology – Tools and Techniques. 2nd edition, Ane Books Pvt. Ltd., New Delhi. 2009.		
Web Resource(s):		
1. https://microbiologysociety.org/static/uploaded/23cbf9c5-f8c8-4f91-b092a4ad819e6357.pdf		
2. https://cevre.erciyes.edu.tr/upload/M6Z30UUmicrobiology-laboratory-manual.pdf		

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Describe the basic principles of sterilization and media preparation.	K1
CO2	Differentiate organisms based on structural and biochemical properties.	K2
CO3	Develop skills associated with isolating and enumerating microorganisms from various sources.	K4
CO4	Evaluate the current understanding of Bacteria and Viruses and their related applications in industry.	K5
CO5	Explicate knowledge and skills gained in this course to be useful in further research.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	2	2	2	2	2	2	2	1	2	3	2.0
CO2	2	2	2	1	2	2	2	2	2	1	1.8
CO3	2	2	2	2	2	2	2	2	3	3	2.2
CO4	3	2	2	2	3	2	2	2	3	3	2.4
CO5	3	2	1	3	3	2	1	2	3	3	2.3
Mean Overall Score											2.3
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Ms. M. Habibunisha

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBT3GE1	Generic Elective - I	2	2	-	100	100
Course Title		EDIBLE MUSHROOM CULTIVATION TECHNOLOGY					
SYLLABUS							
Unit	Contents						Hours
I	Introduction - History - scope of edible mushroom cultivation - Types of edible wild and poisonous mushrooms available in Tamil Nadu and India, widely cultivated varieties in Tamil Nadu- structure and characteristics features of <i>Pleurotus citrinopileatus</i> and <i>Agaricus bisporus</i> . *Magic mushroom and its chemical properties*.						6
II	Pure culture – Substrates used for mushroom cultivation- Preparation of medium (PDA and Oatmeal agar medium) sterilization - preparation of test tube slants to store mother culture – culturing of <i>Pleurotus</i> mycelium on Petriplates, *preparation of mother spawn in saline bottle and polypropylene bag and their multiplication*.						6
III	Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Mushroom bed preparation - paddy straw, sugarcane trash, marine straw and banana leaves. *Factors affecting the mushroom bed preparation - Low cost technology*.						6
IV	Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - *Vitamins*.						6
V	Food Preparation: Types of foods prepared from mushroom; Soup, Cutlet, Omelette, Samosa, Pickles, Curry. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, *Export Value*.						6

..... **Self-study**

<p>Text Books:</p> <ol style="list-style-type: none"> 1. T. Marimuthu, A.S. Krishnamoorthy, K. Sivaprakasam, and R. Jayarajan. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, 2001. 2. M. Swaminathan. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore, 2005
<p>Reference Book(s):</p> <ol style="list-style-type: none"> 1. Tewari and S.C. Pankaj Kapoor. Mushroom cultivation, Mittal Publications, Delhi. 2001. 2. Nita Bahl. Hand book of Mushrooms, II Edition, Vol. I & Vol.II. 1984-1988.
<p>Web Resource(s):</p> <ol style="list-style-type: none"> 1. https://swayam.gov.in/nd2_cec19_ag03/preview 2. https://sites.google.com/site/bbcmicrobiologycbcs/microbiology-courses-in-swayam-portal

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Analyse the commercial importance of edible mushroom cultivation.	K4
CO2	Assess the medicinal and nutritional value of mushroom.	K5
CO3	Determine the marketing value and research findings of mushroom cultivation technology.	K5
CO4	Gain understanding on the different source of raw material for aseptic cultivation and mass production of mushroom.	K6
CO5	Identify and discriminate edible mushroom from poisons.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	1	3	3	2.4
CO2	3	3	3	3	3	2	3	0	3	3	2.3
CO3	3	3	3	2	3	2	2	3	3	3	2.8
CO4	3	3	3	3	2	2	2	3	3	3	3.0
CO5	3	3	2	2	3	2	0	3	3	3	2.6
Mean Overall Score											2.62
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. K. Gobalan

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UCN3AE2	AECC - II	2	2	-	100	100
Course Title		Environmental Studies					

Unit	Contents	Hours
I	The multidisciplinary nature of environmental studies Definition, scope, importance, awareness and its consequences on the planet.	6
II	Ecosystems: Definition, structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	6
III	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. renewable energy resources significance of wind, solar, hydal, tidal, waves, ocean thermal energy and geothermal energy.	6
IV	Biodiversity and Conservation: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns biodiversity hot spots. mega-biodiversity nation; Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: <i>In situ</i> and <i>Ex situ</i> conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	6
V	Environmental Pollution & Conservation: Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution Waste to wealth - Energy from waste, value added products from waste, fly ash utilization and disposal of garbage, solid waste management in urban and rural areas, Swachh Bharat Abhiyan, recent advances in solid waste management, modern techniques in rain water harvesting and utilization.	6

Text books:

1. Asthana DK and Meera A, Environmental studies, 2nd Edition, Chand and Company Pvt Ltd, New Delhi, India, 2012.
2. Arumugam N and Kumaresan V, Environmental studies, 4th Edition, Saras Publication, Nagercoil, Tamil Nadu, India, 2014.

Activity – I:

1. Assignments – Titles on Environmental awareness to be identified by teachers from the following (scripts not less than 20 pages)
2. Elocution – (Speech on “Environment beauty is the fundamental duty” of citizen of the country for 3 to 5 minutes)
3. Environment issues – TV, Newspaper, Radio and Medias messages – Discussion π Case Studies/Field Visit/Highlighting Day today environmental issues seen or heard
4. Debating/Report Submission – Regarding environment issues in the study period Activity II
5. Environmental awareness through charts, displays, models and video documentation.

Celebrating Nationally Important Environmental Days

- National Science Day – 28th February
- World wild life Day – 3rd March
- International forest Day – 21st March
- World Water Day – 22nd March
- World Meteorological Day – 23rd March
- World Health Day – 7th April
- World Heritage Day – 18th April
- Earth / Planet Day – 22nd April
- Plants Day – 26th May
- Environment Day – 5th June Activity III Discipline specific activities

EVALUATION COMPONENT:

Component I: (25 Marks) Document (or) Poster presentation or Elocution

Component II: (25 Marks) Album making (or) case study on a topic (or) field visit

Component III: (25 Marks) Essay writing (or) Assignment submission

Component IV: (25 Marks) Quiz (or) multiple choice question test

Course Outcomes

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-level)
CO1	To understand the multi-disciplinary nature of environmental studies and its importance	K1
CO2	To obtain knowledge on different types of ecosystem	K2
CO3	To acquire knowledge on Renewable and non-renewable resources, energy conservation	K3
CO4	To understand biodiversity conservation	K4
CO5	To analysis impact of pollution and conversion waste to products	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	02	02	02	02	02	03	03	03	03	03	2.5
CO2	02	03	03	02	03	03	03	03	03	03	2.8
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	02	02	03	03	03	03	03	03	03	03	2.8
CO5	02	03	03	03	03	03	03	02	03	03	2.8
Mean Overall Score											2.7
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBT4CC7	Core – VII	5	5	25	75	100
Course Title		MOLECULAR BIOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	Basic concepts of genome and its organisation: Nucleic acid as the genetic material (Griffith's experiment), central dogma of Molecular Biology, Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines. Watson and Crick model of DNA structure, types of DNA, denaturation and renaturation of DNA, melting temperature (T _m), *hyperchromic effect*	15
II	Replication and transcription in eukaryotes and prokaryotes: Semi-conservative replication, coding and non-coding DNA, satellite DNA, junk DNA, palindromes; supercoiling of bacterial DNA, topoisomerases and DNA Gyrase, Gene as the unit of expression- *Co linearity*, Transcription in prokaryotes and eukaryotes, post transcriptional modifications (mRNA, tRNA, rRNA).	15
III	Gene expression and regulation- Genetic code and Wobble hypothesis. Translation: promoter structure and functions. Components of Protein synthesis machinery: mRNA, tRNA structure and function, ribosome structure and assembly, protein synthesis- Initiation, elongation, termination (prokaryotes & eukaryotes) and *post translational modifications*. Principles of gene regulation- negative and positive regulation, Regulation of gene expression in bacteria : operon concept (lac operon, arabinose and trp operon)	15
IV	DNA damage and repair mechanisms- Mutation and genetic analysis of mutants: Mutation definition, types of mutations, Spontaneous and induced, Mutagens: physical and chemical, isolation of mutants and mutagenesis. DNA damage and repair mechanism: Photo reactivation, direct repair of nicks, excision repair, mismatch repair, recombination repair, *SOS repair, double strand repair*.	15
V	Introduction to genetic recombination: Introduction to Restriction/Modification of DNA, ligation, Cloning Vectors, PCR and DNA sequencing techniques * Blotting techniques – Southern, Northern, Western *	15
VI	Current Trends (For CIA only) – Nucleic acid chip analysis, genetic manipulation and genetic engineering approval committee regulations.	

..... **Self-study**

Text Book(s):
1. David P. Clark, Nanette J. Pazdernik, Michelle R. McGehee Molecular Biology, 3 rd Edition, 2018. 2. A. Lizabeth, Allison, Fundamental Molecular Biology, Blackwell Publishing, 3 rd Edition, 2021. 3. W. D.Jeremy and Malcom von Schantz, From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley & Sons, Ltd. 2011.
Reference Book(s):
1. T.A. Brown, Gene cloning and DNA analysis: an Introduction. John Wiley & Sons. 2016. 2. S.B. Primrose and R.M. Twyman, Principles of gene manipulation and genomics. 2016. 3. James. D. Watson Recombinant DNA technology, 2nd edition, WH Freeman and company, New York, 2001. 4. V.A Saunders, Microbial Genetics Applied to Biotechnology: Principles and Techniques of Gene Transfer and Manipulation. Springer Science & Business Media. 2012. 5. D. Freifelder, Molecular Biology, 2nd Edition, Jones and Bartlett Publishers, USA. 2004.

Web Resource(s): 1

1. <https://geneticscertificate.stanford.edu/courses/genetic-engineering-and-biotechnology>
2. <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1586-y>
3. SWAYAM - Genetic Engineering: Theory And Application By Prof. Vishal Trivedi | IIT Guwahati in the current MOOCs course
4. NPTEL Certification course - Gene Therapy by Sachin Kumar
<https://nptel.ac.in/courses/102/103/102103041/>

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Apprehend the genetic makeup of an organism, their structural organisation and functions.	K4
CO2	Appraise about the mechanism of action of genes and how they are involved in regulating biological functions.	K4
CO3	Arrange and apply the tools of genetic manipulation, types of vectors and gene transfer techniques.	K5
CO4	Analyse the mechanisms associated with regulation of gene expression at the level of transcription and translation.	K6
CO5	Explain and employ the techniques involved in amplification and sequencing of genes and genomes.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	1	3	3	2	3	2	2	3	2.5
CO2	3	3	1	3	2	3	3	2	3	3	2.6
CO3	3	2	1	3	2	3	3	3	3	2	2.5
CO4	3	3	2	3	2	3	3	3	3	3	2.8
CO5	3	3	1	3	2	3	3	2	3	2	2.5
Mean Overall Score											2.5
Correlation											High

Course Coordinator: Ms. S. Geet Andrea

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBT4CC8P	Core – VIII	3	3	20	80	100
Course Title		MOLECULAR BIOLOGY - PRACTICAL					

SYLLABUS		
S.NO	Contents	Hours
1.	Isolation of genomic DNA from <i>E. coli</i> .	45
2.	Isolation of plasmid DNA from <i>E. coli</i> .	
3.	Analysis of genomic DNA by agarose gel electrophoresis.	
4.	DNA extraction from agarose gel.	
5.	Restriction digestion and ligation of DNA.	
6.	Transformation.	
7.	Selection / screening of transformants - Blue White screening.	
8.	Primer designing- demonstration	
9.	Amplification of DNA by Polymerase Chain reaction (PCR)	
10.	Western Blotting	

Text Book(s):
1. Joseph Sambrook, Michael R Green, Molecular cloning: A Laboratory Manual by. Cold Spring Harbor publication. 2015. 2. J. Saxena, M. Baunthiyal, I. Ravi, Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers. 2012. 3. James G. Cappuccino and Natalie Sherman. Microbiology: A laboratory Manual, Benjamin Cummings, 10 th Edition 2013.
Reference Book(s):
1. B. John, Laboratory manual for Genetic Engineering, PHI Learning publication. 2010. 2. Ashok Kumar, Molecular Biology and Recombinant DNA Technology: A Practical Book. Narendra Publishing House. 2011. 3. K. V. Chaitanya, Cell and Molecular biology : A Lab Manual – 1st edition, 2013. 4. Hans Bisswanger, Practical Enzymology Wiley-VCH Verlag GmbH & Co, Second Edition. 2012. 5. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology- principles and applications of Recombinant DNA, 4 th edition, ASM press, Washington DC, 2010.
Web Resource(s):
1. https://nptel.ac.in/content/storage2/courses/102103044/module/lec1/1.htm 2. https://nptel.ac.in/content/storage2/coureses/102103047/pdf/modl.pdf 3. https://archive.nptel.ac.in/courses/104/105/104105102/

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Comprehend the skills involved in isolation of genomic and plasmid DNA.	K3
CO2	Compare the development skills associated with isolation, restriction and ligation of the isolated DNA	K4
CO3	Experiment the bacterial transformation techniques by suitable principle and protocols.	K4
CO4	Acquire skills on selection of recombinants and analysis of cloned genes by sequencing methods.	K5
CO5	Explain the principles and applications of Polymerase Chain Reaction (PCR).	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	3	3	1	3	2	3	2	2.5
CO2	3	3	2	3	2	2	2	2	2	2	2.3
CO3	3	3	2	3	2	2	2	3	3	3	2.6
CO4	3	3	1	3	2	3	3	2	3	3	2.6
CO5	3	3	3	3	2	2	2	2	2	2	2.4
Mean Overall Score											2.4
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Ms. S. Geet Andrea

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBT4AC7	Allied – VII	5	4	25	75	100
COURSE TITLE		MICROBIOLOGY II: APPLIED MICROBIOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	Soil Microbiology: Introduction to soil microorganisms – bacteria, algae, fungi, protozoans, nematodes and viruses. Role of microorganisms in biogeochemical cycling - carbon cycle, nitrogen cycle and sulphur cycle. Organic and inorganic nutrients in soil - phosphorous uptake, *nitrogen fixation*, bio fertilizers – definition, importance – types and their application methods. Environmental factors such as pH, temperature, and how land management practices influence the composition.	15
II	Food Microbiology: Food as a substrate for microorganisms – microorganisms important in food microbiology: Molds, Yeasts and Bacteria. Principles and methods of food preservation - high temperature, low temperature, drying, *Irradiation and chemical preservatives*. Spoilage of fruits, vegetables, meat, poultry, fish and sea food. Microbes as foods - SCP production.	15
III	Industrial Microbiology: Industrial products derived from microbes: Production of yeast, ethyl alcohol, beer and vinegar. Citric acid production, lactic acid production. Production of antibiotic – Penicillin and Streptomycin, Vitamin production – Riboflavin, *Vitamin C and vitamin B12, absorption and bioavailability of vitamins*. Role of microbes in biogas production, Petroleum Industry and Mining.	15
IV	Clinical Microbiology: Epidemiology of infectious diseases, Hospital acquired infections, Infections of various organs and systems of the human body, Rapid diagnostic techniques for microbial diseases, Vaccinology: principle, methods of preparation, administration of vaccines, Biological warfare. *Multidrug- Resistant Pathogens*.	15
V	Pharmaceutical microbiology: Key challenges and opportunities facing the pharmaceutical industry - Probiotics and neutraceuticals – economic and legal considerations in pharmaceutical biotechnology, advantages and disadvantages. Chemical and physicochemical deterioration of pharmaceuticals, Preservation of medicines using antimicrobial agents. Types of sterile pharmaceutical products. * Quality control and quality assurance of sterile products*.	15
VI	Current Trends (For CIA only) – Personalized Microbiome Medicine	

*.....*Self Study

Text Book(s):

1. Moshrafuddin Ahmed, Basumatary S.K., Applied Microbiology, MJP Publishers, 2006.
2. Lansing M Prescott, John P Harley and Donald A Klein, Microbiology, 7th Edition, McGraw Hill Publishers, New York, 2007.
3. A. H. Patel, Industrial Microbiology, Lakshmi publications, New Delhi, 2005.

Reference Book(s):

1. David Greenwood, Richard C.B. Slack and John. F. Peutherer; Medical Microbiology, 7th Edition, Elsevier India Private Ltd., New Delhi, 2008.
2. Bernard R. Glick and Jack J. Pasternak. Molecular Biotechnology. Indian edition. Panima Publishing Corporation. 2002
3. R. Y. Stainer, J. L. Ingraham, M. L. Wheelis and P. R. Painter. General Microbiology. Macmillan, 1992.
4. Hugo and Russells, Pharmaceutical Microbiology, edited by Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, Brendan F. Gilmore, 8th edition, Wiley-Blackwell publications, 2008.

Web Resource(s):

1. <https://link.springer.com/book/10.1007/0-306-46888-3>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1529671/>

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Describe the basics of soil microbes and their role in biogeochemical cycle.	K2
CO2	Discuss the domains of microbiology and their applications in various industries.	K3
CO3	Evaluate methods of microbial control and apply the proper methods necessary in a given scenario.	K5
CO4	Explain about the medical and practical uses of microorganisms for the production of pharmaceutical products.	K4
CO5	Employ basic laboratory skills for research in microbiology using scientific methods to explore natural phenomena.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	1	1	2	3	2.4
CO2	3	1	2	1	3	2	1	1	2	1	1.7
CO3	3	1	1	2	3	2	2	2	3	3	2.2
CO4	3	1	1	2	3	2	2	2	3	3	2.2
CO5	3	1	1	3	3	2	1	2	3	3	2.2
Mean Overall Score											2.14
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Ms. M. Habibunisha

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	TOTAL
IV	23UBT4AC8P	ALLIED – VIII	3	2	20	80	100
Course Title		MICROBIOLOGY II: APPLIED MICROBIOLOGY – PRACTICAL					

SYLLABUS		
S.NO	Contents	Hours
1	Isolation of VAM from the soil.	45
2	Study of Rhizobium from legume root nodules.	
3	Isolation and identification of SCP	
4	Isolation and identification of Actinomycetes.	
5	Isolation and identification of bacteria and fungi from vegetables.	
6	Isolation of lactic acid bacteria from curd.	
7	Isolation of probiotic bacteria from Old rice.	
8	Detection of Bacteria in milk by Methylene blue reductase test.	
9	Detection of Bacteria in milk by Phosphatase test.	
10	Antibiotic sensitivity test: Kirby Bauer's method.	
11	Antifungal tests.	
12	Media formulation.	
13	Wine production by yeast.	
14	Yeast Production	
15	Isolation and identification of enzyme producing micro-organisms from soil - (Amylase, Protease, Lipase).	

Text Book(s):
1. James G. Cappuccino and Natalie Sherman. Microbiology: A laboratory Manual. 10th Edition. Benjamin Cummings. 2013. 2. R. H. Baltz, A. L. Demain and J. E. Davies, Manual of Industrial Microbiology and Biotechnology, 3rd edition, ASM Publishers, 2010.
Reference Book(s):
1. K.R. Aneja., Laboratory Manual of Microbiology & Biotechnology, 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2013. 2. Charles Welsh, James Cappucino, Microbiology a lab manual, 2018, 12 th edition
Web Resource(s):
1. https://www.tandfonline.com/doi/full/10.1080/21553769.2015 2. https://microbiologyonline.org/file/7926d7789d8a2f7b207.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Describe the versatile techniques in applied microbiology based practical.	K3
CO2	Employ the designing and conducting experiments involving microbes.	K3
CO3	Analyse the safe methods for isolation of bacteria, fungi and determination of their antibacterial and antifungal activity.	K4
CO4	Construct the application of microbes in industries.	K5
CO5	Formulate the technical skills necessary to support microbiology research study	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	2	1	2	3	2.5
CO2	3	2	2	1	3	2	2	2	2	1	2.0
CO3	3	2	2	2	3	2	2	2	3	3	2.4
CO4	3	2	2	2	3	2	2	2	3	3	2.4
CO5	3	2	1	3	3	2	1	2	3	3	2.3
Mean Overall Score											2.32
Correlation											Medium

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Ms. M. Habibunisha

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBT4GE2	Generic Elective-II	2	2	-	100	100
Course Title		BIOFERTILIZER AND ORGANIC FARMING					

SYLLABUS		
UNIT	CONTENT	HOURS
I	Soil – Physical and chemical properties. Soil fertility- essential nutrients- function, deficiency and toxicities. Concept and methods of soil fertility evaluation. defects of using synthetic fertilizer and pesticides to soil and living organisms.	6
II	Bio-fertilizers - classification, nitrogen fixers- <i>Rhizobium</i> , <i>Azotobacter</i> , <i>Cyanobacteria</i> , <i>Azolla</i> , <i>Frankia</i> , <i>Azospirillum</i> and <i>Vasicular Mycorrhizae</i> .	6
III	Organic farming-definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest management- sustainable agricultural practice, crop rotation, crop diversification, mixed cropping, *biological nitrogen fixation*.	6
IV	Management of organic waste and green manure- Farm manures, composts, Mulches, Tillage and control. Organic manures-organic residue, chemical nature of organic manure, *green manure and its importance*.	6
V	Animal based organic manure-cow dung, poultry waste, Production of vermicompost and *Panchakavya Production* and commercialization of Organic products – conversion period, Inspection and certification (National and International Level).	6

..... **Self Study**

Text Books:
1. A.K.Sharma, Biofertilizers for sustainable agriculture, Agrobios. (2003). 2. Aravind Kumar, Vermes and Vermitechnology, APH Publishing Corporation, New Delhi, (2005)
Books for Reference:
1. G.K.Veeresh, Organic Farming, Foundation Pvt.Ltd., (2006). 2. NIIR Board, The Complete Technology Book on Biofertilizer and organic farming, National Institute of Industrial Research, (2004).
Web Source:
1. http://ec.europa.eu/agriculture/organic/organic-farming/what-organic-en . 2. http://attra.ncat.org/organic.html*list

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO NO.	CO Statement	Cognitive Level (K-Level)
CO1	Employ the knowledge on the properties of soil and soil pollution.	K3
CO2	Examine the knowledge of different types of biofertilizer.	K4
CO3	Explain the organic farming and kinds integrated Pest Management.	K5
CO4	Develop the knowledge by using manure and waste management practice for soil fertility.	K5
CO5	Generate the animal based organic manure production and its importance.	K5

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	2	3	3	2	3	3	3	2.8
CO2	3	2	3	2	2	2	2	2	3	2	2.3
CO3	2	3	2	3	3	2	2	3	3	2	2.5
CO4	2	3	2	3	2	2	2	3	2	3	2.4
CO5	3	3	2	3	2	3	2	2	3	2	2.5
Mean Overall Score											2.5
Correlation											High

Mean Overall Score	Correlation
<1.5	Low
>-1.5 and <2.5	Medium
>-2.5	High

Course Coordinator: Dr. R. Shalini