KG COLLEGE OF ARTS AND SCIENCE
Autonomous Institution | Affiliated to Bharathiar University
Accredited with A++ Grade by NAAC
ISO 9001:2015 Certified Institution
KGiSL Campus, Saravanampatti, Coimbatore – 641 035

Regulations 2024 - 25 for Undergraduate Programme

Learning Outcomes Based Curriculum Framework- (LOCF) model with Choice Based Credit System (CBCS)

Programme: B.Sc. Biotechnology

Programme Code: BBT

(Applicable for the Students Admitted During the Academic Year 2024 - 25 Onwards)

Eligibility

Candidates for admission to the first year of the Bachelor of Science (Biotechnology) Degree Programme should have passed Higher Secondary examination with Chemistry with Biology / Botany/ Zoology/ Microbiology / Biotechnology / Biochemistry / Nutrition & Dietitics / Nursing Vocational group – Agricultural / Food Science / Home Science.
(As per the eligibility condition given by Bharathiar University Ref.BU/R/B3-B4/Eligibility condition/2024/9206 dated 24/5/2024).

Program Learning Outcomes (PLOs)

The successful completion of the B.Sc. Biotechnology programme shall enable the students to

PLO1	Inculcate deeper knowledge in theoretical and practical skills enabling them to work with disciplinary and interdisciplinary domains of biotechnology.
PLO2	Enhance students learning abilities, technological solutions in digital domains of biotechnology for their applications in industry, research and entrepreneurship.
PLO3	Demonstrate their skills to apply approaches and methods in biotechnology for global environmental problems like climate change and waste management.
PLO4	Validate health safety and legal issues ethically with an understanding in the biotechnological principles behind, for society which could fetch career in food and agricultural industry.
PLO5	Understand and apply the Indian Knowledge System (IKS) in emerging biotechnological industry.

B.Sc. Biotechnology

Distribution of Credits and Hours for all the Semesters

Part	Course Category	No. of Courses	Hours		Credits		Total Credits	Semester
I	Language - I	4	4 X 4	16	4 X 3	12	12	1 – 4
II	Language – II	4	4 X 4	16	4 X 3	12	12	1 – 4
III	Core Theory **(6 hrs. / week)**	4	4 X 6	24	4 X 4	16	100	3, 6
	Core Theory **(5 hrs. / week)**	8	8 X 5	40	8 X 4	32		1,2,4,5
	Core Theory **(5 hrs. / week)**	1	1 X 5	5	1 X 3	3		6
	Core Lab **(4 hrs. / week)**	1	1 X 4	4	1 X 2	2		1
	Core Lab **(4 hrs. / week)**	3	3 X 4	12	3 X 3	9		2,3,4
	Core Lab **(5 hrs. / week)**	2	2 X 5	10	2 X 3	6		5
	Allied (5 hrs. / week)	1	1 X 5	5	1 X 4	4		4
	Allied (4 hrs. / week)	1	1 X 4	4	1 X 2	2		3
	Allied (4 hrs. / week)	1	1 X 4	4	1 X 3	3		2
	Allied Lab (4 hrs. / week)	2	2 X 4	8	2 X 2	4		2, 3
	Electives	2	2 X 5	10	2 X 3	6		5 , 6
	Project	1	1 X 6	6	1 X 5	5		6
	Internship (IT)	1	-	-	1 X 2	2		5
	Skill Enhancement (SEC)	3	3 X 2	6	3 X 2	6		3, 4 , 6
IV	Foundation Course (FC)	2	2 X 2	4	2 X 2	4	14	1 – 2
	Foundation Course (FC)	1	-	-	1 X 2	2		3
	Ability Enhancement Compulsory Course(AECC)	3	3 X 2	6	3 X 2	6		1, 2 , 4
	Ability Enhancement Compulsory Course(AECC) – Online Course- MOOC	1	-	-	1 X 2	2		3
V	Liberal Arts – (Extra-Curricular & Co-curricular)	-	-	-	2	2	2	4
	Total	**46**		**180**		**140**	**140**	

Consolidated Semester wise and Component wise Hours and Credits Distribution

Semester	Part I		Part II		Part III		Part IV		Part V		Total	
	Hrs.	Credits	Hrs.	Credits	Hrs.	Credits	Hrs.	Credits	Hrs.	Credits	Hrs.	Credits
1	4	3	4	3	18	13	4	4	-	-	**30**	**23**
2	4	3	4	3	18	13	4	4	-	-	**30**	**23**
3	4	3	4	3	22	15	-	4	-	-	**30**	**25**
4	4	3	4	3	20	15	2	2		2	**30**	**25**
5	-	-	-	-	30	23	-	-	-		**30**	**23**
6	-	-	-	-	30	21	-	-	-	-	**30**	**21**
Total	**16**	**12**	**16**	**12**	**138**	**100**	**12**	**14**	**-**	**2**	**180**	**140**

Curriculum

B.Sc. Biotechnology

Semester – 1									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM11L	I	Language – I	Tamil – I	4	3	25	75	100	3
24HIN11L	I		Hindi – I						
24MAL11L	I		Malayalam – I						
24FRE11L	I		French – I						
24ENG12L	II	Language – II	English – I	4	3	25	75	100	3
24BBT13C	III	Core – I	Cell Biology	5	3	25	75	100	4
24BBT14C	III	Core - II	Genetics	5	3	25	75	100	4
24BBT15P	III	Core Lab - I	**Lab:** Cell Biology & Genetics	4	3	40	60	100	3
24BBT16A	III	Allied – I	Chemistry	4	3	25	75	100	2
24ENV1FC	IV	FC – I	Environmental Studies	2	2	50	-	50	2
24QUA1AE	IV	AECC – I	Quantitative Aptitude	2	2	-	50	50	2
			Total	**30**				**700**	**23**

Semester – 2									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM21L	I	Language – I	Tamil – II	4	3	25	75	100	3
24HIN21L	I		Hindi – II						
24MAL21L	I		Malayalam – II						
24FRE21L	I		French – II						
24ENG22L	II	Language – II	English – II	4	3	25	75	100	3
24BBT23C	III	Core – III	Microbiology	5	3	25	75	100	4
24BBT24C	III	Core – IV	Biochemistry	5	3	25	75	100	4
24BBT25P	III	Core Lab - II	**Lab:**Microbiology & Biochemistry	4	3	40	60	100	3
24BBT26P	III	Allied Lab - I	**Lab:** Chemistry	4	3	40	60	100	2
24HUM2FC	IV	FC - II	Human Rights	2	2	50	-	50	2
24SOF2AE	IV	AECC - II	Soft Skills	2	2	-	50	50	2
Total				**30**				**700**	**23**

Semester – 3									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM31L	I	Language – I	Tamil – III	4	3	25	75	100	3
24HIN31L	I		Hindi – III						
24MAL31L	I		Malayalam – III						
24FRE31L	I		French – III						
24ENG32L	II	Language – II	English – III	4	3	25	75	100	3
24BBT33C	III	Core – V	Bioinstrumentation	6	3	25	75	100	4
24BBT34C	III	Core- VI	Molecular Genetics	6	3	25	75	100	4
24BBT35P	III	Core Lab-IV	**Lab**:Bioinstrumentation & Molecular Genetics Lab	4	3	40	60	100	2
24BBT36A	III	Allied –II	Basics of Biopython	4	3	25	75	100	3
24BBT37P	III	SEC Lab – I	Cheminformatics Lab	2	3	40	60	100	2
24BAT3FC/	IV	FC – II	Basic Tamil	-	2	50	-	50	2
24ADT3FC/			Advanced Tamil						
24IKS3FC			Indian Knowledge Systems(IKS)*						
24MOO3AE	IV	AECC – III	Online Course – MOOC	-	-	50	-	50	2
Total				**30**				**800**	**25**

Semester – 4									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM41L	I	Language – I	Tamil – IV	4	3	25	75	100	3
24HIN41L	I		Hindi – IV						
24MAL41L	I		Malayalam – IV						
24FRE41L	I		French – IV						
24ENG42L	II	Language - II	English – IV	4	3	25	75	100	3
24BBT43C	III	Core Theory-VII	Recombinant DNA Technology	5	3	25	75	100	4
24BBT44P	III	Core Lab -IV	**Lab:**Recombinant DNA Technology	4	3	40	60	100	3
24BBT45A	III	Allied Theory III	Biostatistics	5	3	25	75	100	4
24BBT46P	III	Allied Lab - II	**Lab :** Basics of Bio Python	4	3	40	60	100	2
24BBT47P	IV	SEC Lab II:	**Lab:** Medical Coding	2	2	40	60	100	2
24IDT4AE/	IV	AECC IV	Innovation & Design T hinking/	2	2	-	50	50	2
24IPR4AE/			Intellectual Property Rights/						
24END4AE			Entrepreneurship Development						
24EXC4LA	IV	Extracurricular and co-curricular	Liberal Arts	-	2	50	-	50	2
Total				**30**				**800**	**25**

Semester – 5									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours / Week**	**Examination**				**Credits**
					Duration in Hours	**Max. Marks**			
						CIA	**ESE**	**Total**	
24BBT51C	III	Core- VIII	Plant and Animal Biotechnology	5	3	25	75	100	4
24BBT52P	III	Core Lab-V	**Lab:** Plant and Animal Biotechnology	5	3	40	60	100	3
24BBT53C	III	Core – IX	Immunology	5	3	25	75	100	4
24BBT54P	III	Core Lab -VI	**Lab:** Immunology	5	3	40	60	100	3
24BBT55C	III	Core – X	Bioentrepreneurship	5	3	25	75	100	4
24BBT5AE/	III	Elective – I	Nanobiotechnology/ (**Nanotechnology)**	5	3	25	75	100	3
24BBT5BE/			Bioprocess Technology/ (**Industrial Biotechnology)**						
24BBT5CE			Bioethics and Biosafety **(Bioethics**)						
24BBT56I	III	SEC-III	Internship	-	2	50	-	50	2
Total				**30**				**650**	**23**

Semester – 6									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max. Marks**			
						CIA	**ESE**	**Total**	
	III	Core -XI	Microbial Biotechnology	6	3	25	75	100	4
	III	Core - XII	Pharmaceutical Biotechnology	5	3	25	75	100	3
	III	Core -XIII	Environmental Biotechnology	6	3	25	75	100	4
	III	Elective - II	Drug Designing **(Nanotechnology)**	5	3	25	75	100	3
			Food Science **(Industrial Biotechnology)**						
			Good Laboratory Practice **(Bioethics)**						
	III	SEC - IV	AI in Life Science	2	3	25	75	100	2
	III	Core	Project	6	3	40	60	100	5
Total				**30**				**600**	**21**
Grand Total				**180**				**4250**	**140**

Semester – 1

Part – I : Language I
(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours/ Week	Credits
24TAM11L	Tamil - I	Language-I	4	3

Course Objectives

The course intends to cover

- இலக்கிய வளர்ச்சியை அறிந்துகொள்ளுதல்
- இலக்கியம் படைக்கும் திறன்
- இலக்கிய இலக்கண உரைசெய்தல்
- திறனாய்வு முறையினைக் கற்றுத்தேர்தல்

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	புதுக்கவிதையின் மூலம் வாழ்வியல் விழுமியங்களை உணர்ந்து கொள்ளுதல்.	K1, K2
CLO2	சிறந்த மற்றும் வாழும் கவிஞர்களை அறிந்துகொள்ளுதல்.	K2, K3
CLO3	சிறந்த படைப்பாளர்களின் சிறுகதையில் வெளிப்படும் சமூகச்சிந்தனைகளை அறிந்து விழிப்புணர்வைப் பெறுதல்.	K3
CLO4	தற்கால இலக்கியங்களான புதுக்கவிதை, சிறுகதை தோன்றி வளர்ந்த பின்புலத்தை அறிதல்.	K1, K3
CLO5	மொழியைப் பிழையின்றி பேச, எழுத, கற்கத் தேவையான தமிழ் இலக்கணத்தின் இன்றியமையாமையை உணர்தல். நடைமுறை வாழ்வியலுக்குத் தேவைப்படும் ஆங்கிலக் கடிதத்தைத் தமிழாக்கம் செய்தலுக்கான பயிற்சி பெறுதல்.	K2, K3
K1 - Remember; **K2** - Understand; **K3** – Apply		

Part – I: Tamil – I

Unit	Content	No. of Hours
I	**(நாட்டுப்பற்று)** 1. உலகத்தை நோக்கி வினவுதல் - பாரதியார் 2. பாரதிதாசன் கவிதைகள் - பாரதிதாசன் • தமிழ்ப்பேறு 3. ஒற்றுமையே உயிர்நிலை - கவிமணி 4. தேவதேவன் கவிதைகள் - தேவதேவன் • சாலையும் மரங்களும் செருப்பும் • புதிய வீடு 5. ஆலாபனை - கவிக்கோ அப்துல் ரகுமான் • போட்டி • பாதை 6. புத்தகச் சந்தை - கவிஞர் வாலி	14
II	**(சமூகம்)** 1. எட்டாவது சீர்..... - ஈரோடு தமிழன்பன் 2. தொலைந்து போனேன் - கவிஞர் தாமரை 3. திருநங்கைகள் காகிதப் பூக்கள் - நா. காமராசன் 4. மரங்களைப் பாடுவேன் - வைரமுத்து 5. புள்ளிப் பூக்கள் (ஹைக்கூ) - அமுத பாரதி 6. நாட்டுப்புறப் பாடல்கள் • தாலாட்டுப் பாடல், தெம்மாங்கு பாடல், உழவுத்தொழில்	14
III	**(சிறுகதை)** 1. அகல்யை - புதுமைப்பித்தன் 2. சுமைதாங்கி - ஜெயகாந்தன் 3. அம்மா ஒரு கொலை செய்தாள் - அம்பை 4. சோற்றுக் கணக்கு - ஜெயமோகன் 5. தூரத்து உறவு - வைரமுத்து	12

Unit	Content	No. of Hours
IV	**(இலக்கிய வரலாறு)** 1. மரபுக்கவிதையின் தோற்றமும் வளர்ச்சியும் 2. புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும் 3. ஹைக்கூ கவிதையின் தோற்றமும் வளர்ச்சியும் 4. சிறுகதையின் தோற்றமும் வளர்ச்சியும்	10
V	**(இலக்கணம்)** 1. எழுத்துக்கள் (முதல் எழுத்துக்கள், சார்பெழுத்துக்கள்) 2. எழுத்துக்களின் பிறப்பு 3. மாத்திரைகள் 4. பயிற்சிக்குரியன - மொழிப்பெயர்ப்பு (ஆங்கிலத்திலிருந்து தமிழுக்கு மொழிப்பெயர்த்தல்)	10
	Total Hours	**60**

Reference Books	
1	பாரதி பாடல்கள் ஆய்வுப் பதிப்பு, பேரா. ம ரா போ குருசாமி,(2016) தமிழ்ப் பல்கலைக் கழகம், தஞ்சாவூர்
2	ஆலாபனை, அப்துல் ரகுமான்,(2000) கவிக்கோ பதிப்பகம்
3	தாமரை கவிதைகள், தாமரை, (2012) நியூ செஞ்சுரி புக் ஹவுஸ்
4	தமிழ் இலக்கிய வரலாறு, மு வரதராசனார், (2021) சாகித்திய அகாதெமி பதிப்பு
5	புதிய வெளிச்சத்தில் தமிழ் இலக்கிய வரலாறு, முனைவர் க பஞ்சாங்கம், (2017) அன்னம் வெளியீட்டு
6	தமிழ் இலக்கிய வரலாறு, முனைவர் கா கோ வேங்கடராமன்,(2008) கலையக வெளியீடு
7	நல்ல தமிழ் எழுத வேண்டுமா?, அ கி பரந்தாமனார் எம். ஏ., (2002)அல்லி நிலையம்
8	100 சிறந்த சிறுகதைகள் (தொகுதி 1 & 2) தொகுப்பு: எஸ் ராமகிருஷ்ணன் (2006) பதிப்பகம்: தேசாந்திரி பதிப்பகம்
9	தமிழ் இலக்கணம் எளிய அறிமுகம் , கோ குமரன் (2010) சந்தியா பதிப்பகம்
10	நாட்டுப்புற இயல் ஆய்வு, சு சக்திவேல்,(2012) மணிவாசகர் பதிப்பகம்

Part – II : Language II - English -I

Course Code	Course Name	Category	Hours / Week	Credits
24ENG12L	English - I	Language-II	4	3

Course Objectives

The course intends to cover

- Various genres of literature.
- Active and passive vocabulary.
- Usage of Grammar and Communication.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Identify aesthetic sense and appreciate poetry, enhancing creativity and understanding relevant to professional environments.	K1
CLO2	Understand diverse styles of prose, facilitating versatility in writing and inculcating interpersonal skills.	K2
CLO3	Apply the characters and the narrative techniques in creative writing and content creation ethically.	K3
CLO4	Employ vocabulary and grammatical proficiency in communication to enhance clarity in workplace interactions.	K3
CLO5	Enhance overall communication competence. Practicing these skills in combination reinforces learning and provides students with opportunities to use the language in authentic contexts.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply		

Part - II: English - I

Unit	Content	No. of Hours
I	**Poetry** : Nature 1. I Wandered Lonely as a Cloud - William Wordsworth 2. The Sparrow - Paul Laurence Dunbar 3. Stopping by woods on a snowy Evening – Robert Frost	12
II	**Prose** : Friendship 1. The Man in Black - Oliver Goldsmith 2. Of Friendship - Francis Bacon 3. The Blessing of Friends - Sir John Lubbock	12
III	**Short Stories:** Morality 1. The Necklace – Guy de Maupassant 2. The Lottery - Shirley Jackson 3. The Monkey's Paw - W. W. Jacobs	12
IV	**Language Competency:** Vocabulary 1. Vocabulary : Synonyms, Antonyms, Word Formation 2. Appropriate use of Articles and Parts of Speech 3. Error correction	12
V	**English for Communication** 1. Listening for General and Specific Information. 2. Self - Introduction, Introducing others, Greetings. 3. Reading a prose passage, Reading a poem and Reading a short story 4. Descriptive writing – writing a short descriptive essay of two to three paragraphs.	12
	Total Hours	**60**

Text Books	
1.	Zama, M. (2004). Poetry Down the Ages. Orient Blackswan.
2.	Goldsmith, O. (1869). The Works of Oliver Goldsmith. J. Dicks
3.	Bacon, F., & Montagu, B. (1857). The Works of Francis Bacon (Vol. 1). Parry & McMillan.
Reference Books	
1.	Kumar,V. T. Bhavani, Durga.K. Srinivas.YL. (2018). English in use - A textbook for College Students. (English, Paperback).
2.	Swan, M. (2005). Practical english usage (Vol. 7). Oxford: Oxford university press.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/109105205

Course Code	Course Name	Category	Hours /Week	Credits
24BBT13C	Cell Biology	Core – I	5	4

Course Objectives

The course intends to cover

- The structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- The cellular components are used to generate and utilize energy in cells.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Know the cell discovery and cell organization.	K1
CLO2	Know the mechanisms of cell transport phenomenon.	K1
CLO3	Understand the cell cytoplasmic compartments.	K2
CLO4	Understand the cell division.	K2
CLO5	Understand the communications of cells with other cells and to the environment.	K2
K1 - Remember; **K2** – Understand		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	3	2	2	2
CLO2	3	2	2	3	2
CLO3	-	-	3	3	-
CLO4	2	2	2	-	3
CLO5	1	1	2	1	1
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - I: Cell Biology

Unit	Content	No. of Hours
I	**Basics of Cells**: Cell as a basic unit: Discovery of the cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization.	15
II	**Mechanisms of Cell Transport**: Cell transport phenomenon: Membrane architecture. Active, Passive, diffusion and osmosis. Chemistry of carbohydrates, lipids, proteins and nucleic acids.	15
III	**Cytoplasmic Compartments of The Cell**: Structure and function of cytoplasmic Compartments of the cell: ribosome and protein synthesis, energy flow through mitochondrion, chloroplast and photosynthesis, Golgi apparatus, lysozymes and micro bodies, endoplasmic reticulum, vacuoles, peroxysomes, lysozomes and Nuclear compartment. Heterochromatin and euchromatin, polytene chromosomes.	15
IV	**Cell Division**: Cell division in prokaryotes and eukaryotes: Cell cycle, Mitosis, Meiosis, Crossing over and Characteristics of cancer. Apoptosis, Stem cell, Prions.	15
V	**Specialized Cells and Interaction**: Integrative and specialized cellular events: Cell-cell signaling, specialized cells nerve cells, sperm cells, microfilaments, microtubules, muscle cells. Cells of vision, Nucleocytoplasmic interaction, cell cloning.	15
	Total Hours	**75**

Text Books	
1.	Alberts. B., (2014), Molecular Biology of the cell, W. W. Norton & Company, 6th Edition.
2.	Devasena.T., (2012), Cell Biology, Oxford University Press, New Delhi, 1st Edition
3.	Granger.S., (2018), Text Book of Cell Biology, Callisto Publishers, USA
4.	Kukerti. S, Joshi.D, Sharma.C.S., (2022), Text of Study of Cell Biology, Lambert Publishers,Uttarakhand.
5.	James. D, Watson., (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers
Reference Books	
1.	Cooper.G.M., (2015), The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press, 7th Edition
2.	James. D, Watson.,(2014), Molecular Biology of the Gene, Pearson Publications, 7th Edition.
3.	Karp's.,(2015), Cell and Molecular Biology: Concepts and Experiments. Wiley Publications, 8th Edition.
4.	Lodish.H., (2016), Molecular Cell Biology, W. H. Freeman Publications, 6th Edition.
5.	Plopper.G, Ivankovic.D.B., (2020), Principles of Cell Biology, Jones & Bartlett, USA,3rd Edition.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/102108086
2.	https://nptel.ac.in/courses/102103012

Course Code	Course Name	Category	Hours /Week	Credits
24BBT14C	Genetics	Core – II	5	4

Course Objectives

The course intends to cover

- The concepts of heredity, genes, Mendelian genetics, Blood group inheritance, Genetic map preparation, Human and Population genetics and Recombination.
- Inherited diseases and related traits.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand historical overview of genetic materials for a better appreciation of genetic evolution	K2
CLO2	Gain knowledge on chromosomes, linkage & crossing over to imply on genetic disorders.	K1
CLO3	Understand structure of gene and the genetic material hypothesis	K2
CLO4	Gain knowledge on Mutation.	K2
CLO5	Apply and Analyze the concepts of genetics in genetic counseling.	K3, K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	2	2	2
CLO2	2	-	2	2	2
CLO3	1	3	1	1	1
CLO4	-	1	3	3	3
CLO5	2	2	-	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - II: Genetics

Unit	Content	No of Hours
I	**History of Genetics:** Mendel's experiments, Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes. Epistasis – Lethal genes. Multiple alleles – In drosophila. Rabbit, and Blood group inheritance in man.	15
II	**Linkage and Crossing over:** Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance. Sex Linked Inheritance and Sex Determination in Man.	15
III	**Fine Structure of Gene:** Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sexduction.	15
IV	**Mutation:** Types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy).	15
V	**Population Genetics:** Population Genetics– Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency**.** Eugenics, Euphenics and Euthenics. Pedigree analysis and genetic counselling.	15
	Total Hours	**75**

Text Books

1.	Dr. Veer Bala Rastogi., (2000). Elements of Genetics
2.	Verma, P.S. and Agarwal, V.K., (2022). Genetics, S. Chand & Co.

Reference Books

1.	Gardener E.J. Simmons M.J. Slustad D. P., (2006). Principles of Genetics.
2.	Griffiths, Miller, J.H., (2003). An Introduction to Genetic Analysis W.H. Freeman. New York.
3.	Good Enough U., (1985). Genetics. Hold Saunders international.
4.	Lewis, R., (2001). Human Genetics- Concepts and application. 4th edition. McGraw Hill.
5.	Winter, P.C., Hickey, G.J. and Fletcher., (2010), Instant notes in Genetics. Viva books, Ltd.

Web Resources (Swayam / NPTEL)

1.	https://nptel.ac.in/courses/102104052
2	https://nptel.ac.in/courses/102/103/102103013/

Course Code	Course Name	Category	Hours/Week	Credits
24BBT15P	Cell Biology & Genetics	Core Lab – I	4	3

S. No.	List of Practical's	
1	Laboratory Rules & Regulations. a) Basic reagents preparation & Basic lab instrumentation.	
2	Components of a Compound / Light Microscope.	
3	Blood smear preparation and Identification of Blood cells. Simple staining techniques	
4	Buccal smear preparation and Identification of squamous epithelial cells.	
5	Isolation and Identification of plant cells.	
6	Mitotic stages of onion (Allium cepa) root tip.	
7	Meiotic stages of cockroach testes/ Flower bud.	
8	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands.	
9	Identification of Barr bodies from Buccal smear.	
10	Blood typing in humans for multiple alleles and Rh factor.	
11	Monohybrid cross and Dihybrid cross analysis	
12	Problem solving in Sex Linked Inheritance	
13	Problem solving in Pedigree analysis.	
	Total Hours	**60**

Course Code	Course Name	Category	Hours /Week	Credits
24BBT16A	Chemistry	Allied – I	4	2

Course Objectives

The course intends to cover

- The fundamentals of chemical structure, pH and bonding of water molecules.
- Role of chemistry in day today life.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the importance of bonding and order.	K2
CLO2	Understand the importance of carbohydrates.	K2
CLO3	Apply and Analyze the adulteration in food meticulously	K3, K4
CLO4	Analyse the role as agricultural and textile chemist	K4
CLO5	Analyze the empirical role as a pharmaceutical chemist	K4
K2 – Understand; **K3-** Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	-	2	3
CLO2	3	3	1	-	-
CLO3	-	1	3	1	3
CLO4	2	2	2	2	2
CLO5	3	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Allied - I: Chemistry

Unit	Content	No. of Hours
I	**Atomic theory and Water molecules:** Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Types of chemical bonds. Types of reactions - addition, substitution, elimination, Condensation and polymerization. Chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, Properties, and characteristics of water.	12
II	**Environmental Chemistry**: Concept and scope of environmental Chemistry- Nomenclature: Pollutant, contaminant, receptor, sink, pathways of a pollutant. Water – Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness- water pollution- dissolved oxygen, chemical oxygen demand (COD), biochemical oxygen demand (BOD)-Environmental segments. Atmosphere: Composition and structure of atmosphere, particles, ions and radicals in the atmosphere, Air Pollution: Air Pollutants, e.g. carbon monoxide, nitrogen oxides, hydrocarbons, oxides of sulfur, photochemical smog, acid rain and particulates.	12
III	**Food chemistry:** Food and Nutrition – Carbohydrates, Proteins, Fats, Vitamins and Minerals – Definition, Classification and their importance as food constituents- Balanced diet- Calorie. Food Adulteration- Types and detection methods.	12
IV	**Pharmaceutical Chemistry:** Medicinally important Inorganic compounds: Compounds of Aluminium, Phosphorous, Arsenic, Iron and Mercury. Sulphonamide: mechanism and action of sulpha drugs- preparation and uses of sulphanilamide sulphadiazine & sulphapyridine. Analgesics-definition and actions-narcotic and non narcotic-morphine, Heroin. Heroin. Antipyretic analgesics- preparation and uses - methyl salicylate, aspirin & paracetamol	12
V	**Agricultural and Textile Chemistry:** Fertilizers: Effect of Nitrogen, potassium and phosphorous on plant growth – commercial method of preparation of urea, triple superphosphate. Complex fertilizers and mixed fertilizers – their manufacture and composition. Secondary nutrients – micronutrients – their function in plants. Dyes: azo and triphenylmethane dyes- Preparation one example-Methyl Orange, Malachite green.	12
	Total Hours	**60**

Text Books	
1.	Soni P.L., (2005), A Text book of Organic Chemistry, S. Chand & Sons publications, 11th Edition.
2.	Krishnamurthy. N, Jayasubramanian.K and Vallinayagam., (1990), Applied Chemistry, Prentice Hall of India, New Delhi.
3.	Chang.R and Overby.J., (2017), Chemistry, McGraw-Hill, 14th Edition.
Reference Books	
1.	Jeyashre Ghosh., (2005), A Text book of Pharmaceutical Chemistry, S.Chand & Company, New Delhi.
2.	Meyer L. H., (2006).Text book of Food Chemistry - CBS Publishers, New Delhi.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/104105130
2.	https://nptel.ac.in/courses/104105076

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA									
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Attendance	Active Engagement	Total
			Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage			
100	25	75	50	**5**	50	**5**	**5**	75	**10**	**5**	**5**	**25**

Question Paper Pattern

Component	Duration in Hrs.	Section A			Section B			Section C			Total
		Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	
CIA – I & II	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / ESE	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	Test – I		Test - II		Model		Observation	Total
			Actual	Weightage	Actual	Weightage	Actual	Weightage		
100	40	60	50	**10**	50	**10**	60	**15**	**5**	**40**

Examination Pattern

Component	Duration in Hrs.	Marks			Weightage
		Practical	Record	Total Marks	
Test – I	1	50	-	50	10
Test – II	1	50	-	50	10
Model	3	60	-	60	15
ESE	3	50	10	60	-

Part – IV : Foundation Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours / Week	Credits
24ENV1FC	Environmental Studies	FC- I	2	2

Unit	Content
I	The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.
II	**Natural Resources:** Renewable and non-renewable resources: Natural resources and associated problems. - Forest resources: Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. - Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies. - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
III	**Ecosystems** - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem. - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit	Content
IV	**Biodiversity and its Conservation** - Introduction-Definition: genetic, species and ecosystem diversity. - Bio geographical classification of India. - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. - Biodiversity at global, National and local levels. - India as a mega-diversity nation. - Hot-spots of biodiversity. - Threats to biodiversity: habital loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India. - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
V	**Environmental Pollution Definition** - Causes, effects and control measures of: - a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards - Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.
VI	**Social Issues and the Environment** - From Unsustainable to Sustainable development. - Urban problems related to energy. - Water conservation, rain water harvesting, watershed management. - Resettlement and rehabilitation of people; its problems and concerns. Case studies. - Environmental ethics: Issues and possible solutions. - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. - Wasteland reclamation. - Consumerism and waste products. - Environment Protection Act. - Air (Prevention and Control of Pollution) Act. - Water (Prevention and Control of Pollution) Act. - Wildlife Protection Act. - Forest Conservation Act. - Issues involved in enforcement of environmental legislation. - Public awareness.

Unit	Content
VII	**Human Population and the Environment** - Population growth, variation among nations. - Population explosion-Family welfare Programme. - Environment and human health. - Human Rights. - Value Education. - HIV/AIDS. - Women and Child Welfare. - Role of information Technology in Environment and human health. - Case Studies.
VIII	**Field Work (Practical).** - Visit to a local area to document environmental assets-river/forest/grassland/ hill/mountain. - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. - Study of common plants, insects, birds. - Study of simple ecosystems-pond, river, hill slopes, etc.
	Total Hours **30**
Web Resources	
1.	https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf

Components for Internal Assessment and Distribution of Marks for CIA (Theory)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Total (Best + Model)
50	50	-	Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage	**50**
			50	**25**	50	**25**	**25**	50	**25**	

Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Offline	Open Choice	5 (Out of 8)	5 x 10=50

Part – IV : Ability Enhancement Compulsory Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours/Week	Credits
24QUA1AE	Quantitative Aptitude	AECC - I	2	2

Course Objectives

The course intends to cover

- Basic concepts of numbers, time and work, interests, data representation and graphs
- Concepts of permutation, probability, discounts, percentage & profit loss.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember and Understand the concepts of numbers and average	K1, K2
CLO2	Understand about percentage and apply profit & loss related processing.	K2, K3
CLO3	To understand the concepts of time and work and interest calculations.	K2
CLO4	To understand about the concepts of permutation, combination and probability.	K2
CLO5	Understand , Apply and analyze the concept of problem solving involved in graphs and age.	K2,,K3,K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** -Analyze		

Ability Enhancement Compulsory Course - I: Quantitative Aptitude

Unit	Content	No. of Hours
I	Numbers - Simplification - BODMAS rule - Algebraic formulas - Decimal fractions - Square root and cube roots - Surds and indices - Divisibility rules - HCF and LCM - same remainder - different remainder - application problems – average – equation - mistaken value – replacement - including/excluding.	6
II	Percentage - increase/decrease – netchange – salary – election – marks – consumption - population / machine - profit and loss - profit and loss % - finding cp and sp - profit=loss - same product cp and sp with percentage – discount - ratio and proportion - divided into parts - based on numbers - increase/decrease/ income / expenditure – coins – partnership.	6
III	Time-and-work - individual/combined - alternative days - remaining work - efficiency based - amount split - chain rule - group of male and female or boys - pipes and cistern - finding time - efficiency based – alternative - remaining part - capacity of the tank - simple interest - finding principal - rate of interest – amount -time period - doubles or triples - compound interest - finding rate - finding time, principal - doubles or triples - difference between SI and CI.	6
IV	Permutation - finding value - vowels come together - vowel never comes together - some letters come together - no two vowels come together - vowels in odd/even places - based on repetition - circular permutation – application – combination - finding value and application – probability – coins - dice-cards - balls and miscellaneous problems - odd man out and number series.	6
V	Clock - finding angle - reflex angle - gain or loss – calendars - finding particularday - data interpretation - bar chart - line chart - pie chart – table – combined –ages ratio-twice or thrice - addition /subtraction - family based - problems on numbers - equations.	6
	Total Hours	**30**
Text Book		
1.	R.S. Aggarwal , Quantitative Aptitude, S.Chand & Company Ltd.,	
Reference Book		
1.	Ashish Arora, Quantitative Aptitude.	
Web Resources		
1.	https://www.javatpoint.com/aptitude/quantitative	
2.	https://www.indiabix.com/aptitude/questions-and-answers/	

Components for and Distribution of Marks for ESE (Theory)

Ability Enhancement Compulsory Course(AECC)

Duration in Hours.	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Semester 2

Semester – 2									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM21L	I	Language – I	Tamil – II	4	3	25	75	100	3
24HIN21L	I		Hindi – II						
24MAL21L	I		Malayalam – II						
24FRE21L	I		French – II						
24ENG22L	II	Language – II	English – II	4	3	25	75	100	3
24BBT23C	III	Core – III	Microbiology	5	3	25	75	100	4
24BBT24C	III	Core – IV	Biochemistry	5	3	25	75	100	4
24BBT25P	III	Core Lab - II	**Lab:**Microbiology & Biochemistry	4	3	40	60	100	3
24BBT26P	III	Allied Lab - I	**Lab:** Chemistry	4	3	40	60	100	2
24HUM2FC	IV	FC - II	Human Rights	2	2	50	-	50	2
24SOF2AE	IV	AECC - II	Soft Skills	2	2	-	50	50	2
Total				**30**				**700**	**23**

Course Code	Course Name	Category	Hours/Week	Credits
24TAM21L	Tamil – II	Language – I	4	3

Course Objectives

The Course intends to cover

- தமிழ் இலக்கியம் கற்பதன் மூலம் நாகரிகம் மற்றும் பண்பாட்டைப் புரிந்துகொள்ளுதல்.
- தனிப்பட்ட வளர்ச்சி, படைப்பாற்றல் திறனை வளர்த்தல்.
- வாழ்வியல் அறங்களைக் கற்றல் மற்றும் வாழ்வைச் செழுமையாக்க உதவும் நன்னெறிகளை அறிதல்.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	அற இலக்கியங்கள் வழி வாழ்வியல் ஒழுக்கங்களைக் கற்றுத் தருதல்.	K1, K2
CLO2	பக்தி இலக்கியங்கள் வழி பக்தி நெறிகளை உணர்த்துதல்.	K2
CLO3	தமிழில் உரைநடை இலக்கியப் படைப்பாளர்களின் சிந்தனைகளை எடுத்துரைத்தல்.	K3
CLO4	தமிழ் இலக்கிய வரலாற்றில் அற இலக்கியம் மற்றும் உரைநடையின் தாக்கம் குறித்து அறிதல்.	K1, K3
CLO5	பிழையின்றி எழுத இலக்கணங்களைக் கற்றுத் தருதல்.	K2, K3
K1 - Remember; **K2** - Understand; **K3** – Apply		

Part – I: Tamil – II

Unit	Content	No. of Hours
I	**(அறம்)** 1. திருக்குறள் • புகழ் • வினை செயல்வகை • நெஞ்சொடு கிளத்தல் 2. திரிகடுகம்(தேர்ந்தெடுக்கப்பட்ட 10 பாடல்கள்) 3. பழமொழி நானூறு(தேர்ந்தெடுக்கப்பட்ட 10 பாடல்கள்)	**14**
II	**(பக்தி)** 1. அபிராமி அந்தாதி(10 பாடல்கள்) - அபிராமி பட்டர் 2. உமர்கயாம் பாடல்கள் (தனிப்பாடல்கள்) - கவிமணி தேசிய விநாயகம் பிள்ளை 3. முத்துக்குமாரசாமி பிள்ளைத்தமிழ்(தாலப் பருவம்) – குமரகுருபரர் 4. இயேசுகாவியம் - மலைப்பொழிவு - கண்ணதாசன் 5. சித்தர் பாடல்கள் - சிவவாக்கியர் பாடல்	**14**
III	**(கலை மற்றும் பண்பாடு)** 1. அறம் எனப்படுவது - அமுதன் 2. ஏட்டில் எழுதா இலக்கியம் - ஔவை துரைச்சாமி 3. கீழடி - தொல்லியல் துறை, வெளியீடு 4. மனம் எனும் சொர்க்கவாசல் - டாக்டர் எம்.எஸ்.உதயமூர்த்தி 5. ஆளுமைத் திறன் - அறிவுக்கதிர் (அரசுப்பணி சிறப்பிதழ்)	**12**
IV	**(இலக்கிய வரலாறு)** 1. பதினெண் கீழ்க்கணக்கு நூல்கள் 2. உரைநடையின் தோற்றமும் வளர்ச்சியும்	**10**
V	**(இலக்கணம்)** 1. சொல்லின் வகைகள் 2. வேற்றுமைத் தொகைகள் 3. பயிற்சிக்குரியன:(விண்ணப்பங்கள், மடல்கள் எழுதச் செய்தல்)	**10**
	Total Hours	**60**

Reference Books	
1	முத்துக்குமாரசாமி பிள்ளைத்தமிழ்,(2021) கமலா முருகன், சாரதா பதிப்பகம்
2	இயேசு காவியம், கவிஞர் கண்ணதாசன்,(2006) கலைக்காவிரி பதிப்பகம்
3	உரைகளும் உரையாசிரியர்களும்,(2013) தி சு நடராசன் நியூ செஞ்சுரி புக் ஹவுஸ்
4	அபிராமி அந்தாதி, முனைவர் சி சேதுராமன்,(2010) நியூ செஞ்சுரி புக் ஹவுஸ்
5	புதிய வெளிச்சத்தில் தமிழ் இலக்கிய வரலாறு, முனைவர் க பஞ்சாங்கம், (2017) அன்னம் வெளியீட்டு
6	தமிழ் இலக்கிய வரலாறு, மு வரதராசனார்,(2021) சாகித்ய அகாடமி பதிப்பு
7	தமிழ் உரைநடை வரலாறு, வி செல்வநாயகம்,(2003) அடையாளம் பதிப்பகம்
8	தமிழ் இலக்கிய வரலாறு, முனைவர் கா கோ வேங்கடராமன்,(2010) கலையக வெளியீடு
9	எண்ணங்கள் - டாக்டர் எம் எஸ் உதயமூர்த்தி,(2016) வெளியீடு: கங்கை புத்தக நிலையம், சென்னை
10	அடோன் தமிழ் இலக்கணம், புலவர் பொன்மணிமாறன்,(2011) அருண் பப்ளிஷிங்

Part – II : English - II

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours/ Week	Credits
24ENG22L	English-II	Language - II	4	3

Course Objectives

The course intends to cover

- The literary elements in poetry.
- The critical contemplation and writing in styles of prose texts.
- The modernist techniques and ethics in the narratives of short stories.
- The interpersonal skills essential in the work environment.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Identify the common techniques underlying free verse and traditional forms of poetry for crafting poems.	K1
CLO2	Understand humour in prose texts psychologically to master the oratory skills.	K2
CLO3	Employ empathy and morale in diplomatic Day-to-day circumstances.	K3
CLO4	Strengthen the writing skills for documentation.	K3
CLO5	Persist flexibility and mobility in the sequel LSRW.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply		

Part – II : English - II

Unit	Content	No. of Hours
I	**Poetry**: Motherhood 1. My Grand Mother's House – Kamala Das 2. Of mother, among others things – A.K Ramanujam 3. Night of the Scorpion – Nissim Ezekiel	12
II	**Prose**: Humour 1. With The Photographer – Stephen Leacock 2. Travel by Train – J.B.Priestley 3. On Forgetting – Robert Lynd	12
III	**Short Stories:** Integrity 1. The taxi driver – K.S. Duggal 2. A Retrieved Reformation- O Henry 3. Kabuliwala - Rabindranath Tagore	12
IV	**Language Competency:**Vocabulary 1. Homonyms, Homophones, Homographs Portmanteau words 2. Verbs and Tenses, Subject Verb Agreement 3. Error correction Vocabulary : Synonyms, Antonyms, Word Formation	12
V	**English for Communication** 1. Listening with courtesy and adding ideas and giving opinions during the meeting and making concluding remarks 2. Participating in a meeting: face to face and online 3. Reading news and weather reports 4. Preparing first drafts of short assignments	12
	Total Hours	**60**

Text Books	
1.	Ezekiel Nissim, 1989 .Collected Poems 1952-1988. Oxford University Press.
2.	Hewings, M. (2000). Advanced English Grammar. Cambridge. University Press.
Reference Books	
1.	Bakshi, S.P. & Sharma, R. (2019). Descriptive English. Arihant Publications (India) Ltd.
2.	Cameron S & Dempsey L. (2019). The Reading Book: A Complete Guide to Teaching Reading. S & L. Publishing.
3.	Sherman B. (2014) Skimming and Scanning Techniques. Liberty University Press.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/109103020

Course Code	Course Name	Category	Hours /Week	Credits
24BBT23C	Microbiology	Core – III	5	4

Course Objectives

The course intends to cover

- The basics of microbiology - types of microbes, classification and characterization, various applied aspects of microbes in biotechnology.
- The pathological aspects by identifying the diseases.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Know history & classifications of microbes.	K1
CLO2	Understand and differentiate the different types of microbes.	K2
CLO3	Apply the knowledge on culturing techniques.	K3
CLO4	Analyze the Microbial pathology and apply the knowledge in control measures.	K3
CLO5	Apply the knowledge on the economic importance of microbes in Food and Agro industry	K3, K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	2	2	2	-	3
CLO3	2	3	-	3	3
CLO4	2	-	3	2	-
CLO5	3	3	1	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - III: Microbiology

Unit	Content	No. of Hours
I	**Microbes and their Classifications:** History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae – classical and molecular approaches. Scope of microbiology – Role of microbes in industries	15
II	**Media and Culture Methods:** Structure of bacteria - Bacterial growth and measurement of growth, Media – types and preparation- plating methods - staining methods (Gram's, capsule, spore, LCB mount)- methods of preservation and storage of microbes. Culture of fungi, virus and algae.	15
III	**Methods of Sterilization:** Sterilization methods - physical and chemical methods- Mode of action – Antibiotic in clinical use - Resistance to antimicrobial agents - MRSA, ESBL, Retro & non retro virus, systemic-griseofulvin, topical-candidiasis- ketoconazole.	15
IV	**Microbial Disease:** Microbial Disease- host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria). Parasite- Trypanosomiasis. Sars Covi 2.	15
V	**Applications of Microbes:** Bioinsecticides-*Bacillus thuringiensis*, Baculoviruses - Biofertilizers - *Azospirillum* and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt).	15
	Total Hours	**75**

Text Books	
1.	Ananthanarayanan, Panicker, Kapil., (1987), Textbook book of Microbiology, Orient Black Swan.
2.	Dubey R.C. and Maheswari, S., (2003). A Textbook of Microbiology, S. Chand & Co., NeW Delhi.
3.	Pelczar.M. J, Chan E.C.S. and Noel. R.K., (2007). Microbiology, McGraw –Hill, New York, 7th Edition.
4.	Prescott, Harley, Klein., (2016), Microbiology, McGraw – Hill, 10th Edition.
Reference Books	
1.	Boyd. R.F., (1998), General Microbiology, Times Mirror, Mosby College Publishing, St Louis, 2nd Edition.
2.	Bamford.G.,(2012), Medical Microbiology and Infection at a Glance,Wiley- Blackwell,4th edition.
3.	Madigan, Bender, Buckley, Stahl., (2019), Brock Biology of Microorganisms, Pearson Publishers,USA,14th edition.
4.	Salle.A.J., (1992), Fundamental Principles of Bacteriology, McGraw Hill Inc. New York.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/102105087
2.	https://onlinecourses.nptel.ac.in/noc21_ce07

Course Code	Course Name	Category	Hours /Week	Credits
24BBT24C	Biochemistry	Core – IV	5	4

Course Objectives

The course intends to cover

- Structure, classification and functions of biomolecules.
- Metabolism of biomolecules.

Course Learning Outcomes

On the successful completion of the course, the students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Know the importance of bonding and order.	K1
CLO2	Understand the importance of carbohydrates.	K2
CLO3	Understand the notion of proteins, lipids.	K2
CLO4	Obtain a basic knowledge of structure and functions of bio-molecules.	K2
CLO5	Understand how energy is generated and utilized biochemically.	K2
K1-Remember; **K2** – Understand.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	-	2	3
CLO2	3	3	1	-	-
CLO3	-	1	3	1	3
CLO4	2	2	2	2	2
CLO5	3	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - IV: Biochemistry

Unit	Content	No. of Hours
I	**Biomolecules:** Structure of atoms and biomolecules: Atomic theory, Valency, Atomic weight, Molecular weight, Molarity. Chemical Bonding - Electrostatic, Covalent, Ionic and Vander waals, Structure of water molecules, properties and ionization of Water, pH and buffers. Laws of Thermodynamics	15
II	**Classification & Metabolism of Carbohydrates:** Importance of Biochemistry. Structure, Classification, Properties, and Metabolism of Carbohydrates. Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.	15
III	**Structure and Classification of Proteins:** Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins.	15
IV	**Metabolism of Lipids & Nucleic acids:** Metabolism of Fatty acids, triglycerides, phospholipids. Classification and Metabolism of nucleic acids, salvage pathway. Degradation of amino acids and urea cycle.	15
V	**Enzymes, Vitamins and Hormone:** Enzymes – Nomenclature, Mode of action and types. Role of Vitamins and Hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.	15
	Total Hours	**75**

Text Books	
1.	Shourie.A, Shilpa.S, Chapadgoankar and Anamika Singh., (2021), Textbook of Biochemistry, Wiley–India Publishers.
2.	Deb.A.C., (2016), Fundamentals of Biochemistry, New central book agencies, Kolkata, 7th edition.
3.	Jain. J.L., (2016), Fundamentals of Biochemistry, S. Chand publication, Noida,7th edition.
4.	Satyanarayana.U., (2016), Biochemistry, MJ publishers, 3rd edition.
5	Soni.P.L., (2005), A Text-book of Organic Chemistry, S. Chand & Sons publications, India, 11th Edition.
Reference Books	
1.	Arun.B, Bahl.B.S., (2016), A Textbook of Organic Chemistry, S. Chand & Sons publications, Noida, 22nd Edition.
2.	Geoffrey L. Zubay, William W. Parson, Dennis E. Vance., (1995), Principles of Biochemistry, W.C. Brown Publishers.
3.	Lehninger., (2013), Principles of Biochemistrty WH Freeman and Company ,NY, 4th edition.
4	Stryer.L., (2007), Biochemistry , W H Freemann and company, San Francisco, 5th Edition.
5	Murray et al., (2003), Harper's Biochemistry, Appleton and Lange Publishers, Florida USA, 26th edition.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/104105130

Course Code	Course Name	Category	Hours /Week	Credits
24BBT25P	Microbiology & Biochemistry	Core Lab - II	4	2

S. No.	List of Practicals
1.	Sterilization techniques, Preparation of Media and Maintenance of culture.
2.	Inoculation techniques- Pour plate, Spread plate and Streak plate.
3.	Isolation of bacteria from various sources and dilution techniques.
4.	Staining techniques: Gram's, Capsule (Negative), Spores.
5.	Preparation of temporary mounts- Lactophenol cotton blue staining.
6.	Motility tests: Hanging drop technique.
7.	Biochemical characterization - Catalase, Oxidase, IMVIC test and TSI.
8.	Antibiotic sensitivity test.
9.	Estimation of Ascorbic acid
10.	Estimation of sugars- Glucose & Fructose.
11.	Estimation of Cholesterol- Zak's method.
12.	Estimation of total free amino acids.
13.	Estimation of Proteins – Bradford's method.
	Total Hours **60**

Text Books

1.	Benson H.J., (1998). Microbiological applications: A laboratory manual in general microbiology, WCB/McGraw-Hill Publishers, USA.
2.	Cappuccino., (2005), Microbiology: A Laboratory Manual, Pearson Education, UK.

Course Code	Course Name	Category	Hours /Week	Credits
24BBT26P	Chemistry	Allied Lab - I	4	2

S. No.	List of Practicals
I	**Systematic analysis of Organic compounds**
1.	Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam).
2.	Detection of elements (N, Halogens).
3.	Distinguish between aliphatic and aromatic compounds.
4.	Distinguish between Saturated and unsaturated compounds.
II	**Qualitative Analysis**
1.	Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, Maltose, Sucrose and Starch
2.	Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.
III	**Volumetric Analysis**:
1.	Estimation of Glycine- Formal Titration.
2.	Determination of Ascorbic acid – DCPIP method.
3.	Estimation of Ferrous sulphate using standard Mohr's salt.
	Total Hours **60**
Text Books	
1.	Venkateswran.V, Veerasmy.R, and Kulandavelu A. R., (1997), Basic principles of Practical Chemistry, Sultan Chand and Sons Publishers.
2.	Joy P.P, Surya.S and Awathy., (2015), Laboratory Manual of Biochemistry, Web: www.kau.edu/prsvkm, http://prsvkm.tripod.com.

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA									
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Attendance	Active Engagement	Total
100	25	75	Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage	5	5	25
			50	5	50	5	5	75	10			

Question Paper Pattern

Component	Duration in Hrs.	Section A			Section B			Section C			Total
		Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	
CIA – I & II	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / ESE	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	Test – I		Test - II		Model		Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Actual	Weightage	5	40
			50	10	50	10	60	15		

Examination Pattern

Component	Duration in Hrs.	Marks			Weightage
		Practical	Record	Total Marks	
Test – I	1	50	-	50	10
Test – II	1	50	-	50	10
Model	3	60	-	60	15
ESE	3	50	10	60	-

Part – IV : Foundation Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours / Week	Credits
24HUM2FC	Human Rights	FC - II	2	2

Unit	Content
I	**Concept of Human Values, Value Education Towards Personal Development** Aim of Education and Value Education; Evolution of Value Oriented Education; Concept of Human Values; Types of Values; Components of Value Education. **Personal Development:** Self-analysis and Introspection; Sensitization towards Gender Equality, Physically Challenged, Intellectually Challenged. Respect to - Age, Experience, Maturity, Family Members, Neighbors, Co-workers. Character Formation towards Positive Personality: Truthfulness, Constructively, Sacrifice, Sincerity, Self-Control, Altruism, Tolerance, Scientific Vision.
II	**Value Education Towards National and Global Development** **National and International Values:** Constitutional or National Values - Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, and Fraternity. Social Values - Pity and Probity, Self-Control, Universal Brotherhood. Professional Values - Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, and Faith. Religious Values - Tolerance, Wisdom, Character. Aesthetic Values - Love and Appreciation of Literature and Fine Arts and Respect for the Same. National Integration and International Understanding.
III	**Impact of Global Development on Ethics and Values** Conflict of Cross-Cultural Influences, Mass Media, Cross-Border Education, Materialistic Values, Professional Challenges, and Compromise. Modern Challenges of Adolescent Emotions and Behavior; Sex and Spirituality: Comparison and Competition; Positive and Negative Thoughts. Adolescent Emotions, Arrogance, Anger, Sexual Instability, Selfishness, Defiance
IV	**Therapeutic Measures** Control of the Mind through a. Simplified Physical Exercise b. Meditation – Objectives, Types, Effect on Body, Mind and Soul c. Yoga – Objectives, Types, Asanas d. Activities: (i) Moralisation of Desires (ii) Neutralisation of Anger (iii) Eradication of Worries (iv) Benefits of Blessings

Unit	Content
V	**Human Rights** 1. Concept of Human Rights – Indian and International Perspectives a. Evolution of Human Rights b. Definitions under Indian and International Documents 2. Broad Classification of Human Rights and Relevant Constitutional Provisions. a. Right to Life, Liberty and Dignity b. Right to Equality c. Right against Exploitation d. Cultural and Educational Rights e. Economic Rights f. Political Rights g. Social Rights 3. Human Rights of Women and Children a. Social Practice and Constitutional Safeguards (i) Female Feticide and Infanticide (ii) Physical Assault and harassment (iii) Domestic Violence (iv) Conditions of Working Women 4. Institutions for Implementation a. Human Rights Commission b. Judiciary 5. Violations and Redressal a. Violation by State b. Violation by Individuals c. Nuclear Weapons and terrorism d. Safeguards
Total Hours	**30**

Web Resources	
1.	https://syllabus.b-u.ac.in/syl_college/ug_ve.pdf

Components for Internal Assessment and Distribution of Marks for CIA (Theory)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Total (Best + Model)
50	50	-	Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage	50
			50	**25**	50	**25**	**25**	50	**25**	

Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Offline	Open Choice	5 (Out of 8)	5 x 10=50

Part – IV : Ability Enhancement Compulsory Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours / Week	Credits
24SOF2AE	Soft Skills	AECC – II	2	2

Course Objectives

The course intends to cover

- The essential soft skills that is crucial for success in today's dynamic and interconnected workplace.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the comprehensive skills to participate actively in conversation, writing short texts with expression	K1, K2, K3
CLO2	Infer the cohesive devices to describe and discuss any objects, pictures using compound, complex sentence forms.	K2, K3
CLO3	Comprehend the logic in the given situation to organize the ideas to write formal and informal letters.	K2, K3
CLO4	Understand the given material to organize it in a logical sequence to present a paragraph with main and supporting ideas with concluding sentences.	K3
CLO5	Present valuable ideas in conversation to emulate the main ideas and key points in short essays.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply;		

Ability Enhancement Compulsory Course - II : Soft Skills

Unit	Content	No. of Hours
I	**Presentation Skills : Getting to Know You:** Grammar: Introduction to Tenses; Listening: Fill in the blanks; Speaking: Self Introduction, Everyday English, Role-Play; Reading: Different ways of communication. **My Day:** Grammar: Present simple positive & negative / Adverbs of Frequency; Vocabulary & Speaking: Daily Activities; Listening: Observe and Answer / Telling the time; Reading & Writing: Describe where you live. **Your World:** Grammar: Possessive determiners; Vocabulary & Speaking: Talk about countries, nationalities; Listening: Positive & negative contractions; Reading & Writing: Personal profile. **The World Of Work:** Grammar: Yes/No & Wh Questions; Vocabulary & Speaking: Jobs; Listening: Recognize the schwa sound; Reading & Writing: Opening and closing an email. .**Places And Things:** Grammar: There is / there are, articles; Vocabulary & Speaking: Talk about rooms & furniture; Listening: Directions; Reading & Writing: Imperatives.**24 Hours:** Grammar: Likes & Dislikes; Vocabulary & Speaking: Speak about hobbies and interests; Listening: Observe & answer; Reading: Match the photos with descriptions; Writing: Write complete sentence using prompts;	6
II	**Confidence : Clothes and Shopping:** Grammar: Modal verbs / Adverbs of Frequency / Adjectives and Adverbs; Vocabulary & Speaking: Shopping; Listening: Observe and Answer; Reading & Writing: Product Review. **Travel & Transport:** Grammar: Past simple questions; Vocabulary & Speaking: Talk about holidays; Listening: At the train station; Reading & Writing: Email - A perfect holiday. **Health & Fitness:** Grammar: Past simple irregular verbs; Vocabulary & Speaking: Talk about a healthy lifestyle; Listening: Listen & Answer; Reading & Writing: Time sequencers. **Music:** Grammar: Present perfect simple; Vocabulary & Speaking: Survey about music; Listening: Listen two people talk about music; Reading: Use adjectives and create sentences. **Let's go shopping:** Grammar: Countable & Uncountable; Vocabulary & Speaking: Town Survey; Listening: Listen and answer; Reading & Writing: Read and match	6
III	**Creativity :Cooking & Eating:** Grammar: Some & Any, Quantifiers; Vocabulary & Speaking: Food & Drink; Listening: Kitchen conversation; Reading & Writing: Article reading & answering. **Survival:** Grammar: Comparison of adjectives; Vocabulary & Speaking: Describing people; Listening: Listen & Answer; Reading & Writing: Read and Answer. **Working Together:** Grammar: Verb + Noun phrases; Vocabulary & Speaking: Talk about technology; Listening: Listen & Answer; Reading & Writing: Notice. **Music:** Grammar: Present perfect simple; Vocabulary & Speaking: Survey about music; Listening: Listen two people talk about music; Reading: Use adjectives and create sentences. **Culture and Arts:** Grammar: Present perfect; Vocabulary & Speaking: Speak on the phone; Listening: Listen and answer; Reading & Writing: Review	6

Unit	Content	No. of Hours
IV	**Problem-Solving :Do's and Don'ts:** Grammar: Modal verbs; Vocabulary & Speaking: Role play; Listening: Holidays in January; Reading & Writing: Article reading & answering. **Body:** Grammar: First conditional; Vocabulary & Speaking: Personality & Appearance; Listening: Listen to conversations about personality; Reading & Writing: Read and Answer about your skills. **Speed:** Grammar: Present simple passive; Vocabulary & Speaking: Talk about relationships; Listening: Listen & Answer; Reading & Writing: Error spotting. **Work:** Grammar: Adverbs of manner; Vocabulary & Speaking: Talk about work advice; Listening: Observe & Answer; Reading: Read & check your ideas	6
V	**Critical Thinking : Influence:** Grammar: would / past habits; Listening: Sentence Correction; Speaking & Vocabulary: Your inspiration; Reading: Picture description; Writing: Rewrite the sentences. **Money:** Grammar: Second conditional; Listening: radio programme; Speaking & Vocabulary: Talk about games; Reading & Writing: Fill in the blanks. **Things that changed the world:** Grammar: articles; Speaking & Listening: Talk about chewing gum; Reading & Writing: Read and write a book review	6
	Total Hours	**30**

Components for and Distribution of Marks for ESE (Theory)
Ability Enhancement Compulsory Course(AECC)

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Semester – 3

Semester – 3									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours /Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM31L	I	Language – III	Tamil – III	4	3	25	75	100	3
24HIN31L	I		Hindi – III						
24MAL31L	I		Malayalam – III						
24FRE31L	I		French – III						
24ENG32L	II	English – III	English – III	4	3	25	75	100	3
24BBT33C	III	Core – V	Bioinstrumentation	5	3	25	75	100	4
24BBT34C	III	Core- VI	Molecular Genetics	5	3	25	75	100	4
24BBT35P	III	Core Lab-IV	**Lab**: Bioinstrumentation & Molecular genetics	4	3	40	60	100	2
24BBT36A	III	Allied –II	Basics of Biopython	4	3	25	75	100	3
24BBT37P	III	SEC Lab – I	Cheminformatics Lab	2	3	40	60	100	2
24BAT3FC/	IV	FC – II	Basic Tamil	-	2	50	-	50	2
24ADT3FC/			Advanced Tamil						
24IKS3FC			Indian Knowledge Systems(IKS)*						
24MOO3AE	IV	AECC – III	Online Course – MOOC	-	-	50	-	50	2
Total				**30**				**800**	**25**

Part –I : Tamil –III

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours / Week	Credits
24TAM31L	Tamil - III	Language - I	4	3

Course Objectives

The course intends to

- தமிழரின் பிற துறை சார்ந்த சிந்தனைகளைக் கற்றுத் தேர்தல்
- இன்றைய அறிவியல் வளர்ச்சி மற்றும் கணினியின் பயன்பாட்டுத் தேவையை உணர்த்துதல்
- இயற்கை பாதுகாப்பு குறித்த விழிப்புணர்வை வளர்த்தல்

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	வணிகத் தமிழ் - கணினித் தமிழின் நுட்பங்கள் மற்றும் பயன்பாடுகளை அறிதல்.	K1, K2
CLO2	ஊடகம் மற்றும் உளவியல் தன்மை குறித்த சிந்தனைகளை வளர்த்தல்.	K2
CLO3	சுற்றுலா - சுற்றுச்சூழலியல் தேவை மற்றும் மீட்டுருவாக்கம் குறித்து உணர்த்துதல்.	K3
CLO4	மேலாண்மை பற்றி அறிதல் மற்றும் சுயக்கற்றல் திறனை வளர்த்தல்.	K1, K3
CLO5	கொங்கு ஆளுமைகள் குறித்து அறியச் செய்தல்.	K2, K3
K1 - Remember; **K2** - Understand; **K3** – Apply		

Part – I: Tamil – III

பயன்பாட்டுத் தமிழ்

Unit	Content	No. of Hours
I	**வணிகம் மற்றும் கணினித் தமிழ்** தமிழரின் வணிகம் - வணிகக் கடிதங்கள் – உலகமயமாக்கல் - செயற்கை நுண்ணறிவு கற்றல் - இணைய நூலகம் - இணையத் தமிழ் பயன்பாடு	12
II	**ஊடகம் மற்றும் உளவியல் தமிழ்** ஊடகத்தின் இன்றியமையாமை - நிகழ்வுகளைச் செய்திகளாக வடிவமைத்தல் - ஊடகத் துறையில் மொழியின் பங்கு - உளவியல் வரையறை - உளவியல் பிரிவுகள் - வகுப்பறை உளவியல் (ஆசிரியர், மாணவர்)	12
III	**சுற்றுச்சூழலியல் மற்றும் சுற்றுலாவியல்** தமிழரின் சூழலியல் அறிவு - சுற்றுச்சூழல் மாசுபாடு - சுற்றுச்சூழல் பாதுகாப்பு - சுற்றுலா வகைகள் - உலகப் புகழ்பெற்ற சுற்றுலாத் தலங்கள் - சுற்றுலா வளர்ச்சி மற்றும் பயன்கள்	12
IV	**மேலாண்மைத் தமிழ் மற்றும் மொழிப்பயிற்சி** மேலாண்மையும் அணுகுமுறைகளும் - மேலாண்மை செயல்பாடுகள் மற்றும் வகைகள் - வகுப்பறை மேலாண்மை – நேர்காணல் - நூல் திறனாய்வு மற்றும் மதிப்பீடு - படிவங்கள் பூர்த்தி செய்தல் மற்றும் விண்ணப்பங்கள்	12
V	**பன்முக ஆளுமைகள்** ஜி.டி.நாயுடு(அறிவியல்) – பத்மஸ்ரீ டாக்டர் பக்தவத்சலம்(மருத்துவம்) - நா மகாலிங்கம்(தொழில்) - மயில்சாமி அண்ணாதுரை(விஞ்ஞானம்) - என் ஜி ராமசாமி(சமூகம்) - நம்மாழ்வார்(விவசாயம்)	12
	Total Hours	60

Reference Books

1	சுந்தரம்.இல, (2022) கணினித் தமிழ், விகடன் பிரசுரம்
2	மணியரசன்.துரை, (2019), இணையமும் இனியத் தமிழும், இசை பதிப்பகம்
3	பொன்னவைக்கோ.மு, (2015) இணையத் தமிழ் வரலாறு, பாரதிதாசன் பல்கலைக் கழகம்.
4	தங்கமணி இரா.ம, (2018) சுற்றுலாவியல், கொங்கு பதிப்பகம்
5	இலக்கியா க.வி, நந்தினி சா.சு,(2022), விடியல் பதிப்பகம்

Reference Books	
6	சின்னத்தம்பி முருகேசன்.பொன்(2016) சுற்றுச் சூழலியல்(உலகம் தழுவிய வரலாறு), எதிர் வெளியீடு
7	இறையன்பு.வெ (2018) இலக்கியத்தில் மேலாண்மை, நியூ செஞ்சுரி புக் ஹவுஸ்
8	ஸ்ரீனிவாசன்.வி, (2009), திருக்குறளில் மேலாண்மை, விகடன் பிரசுரம்
9	பட்டனத்தி மைந்தன், (2018), ஜி.டி நாயுடு, ராமையா பதிப்பகம்
10	டாக்டர் பக்தவத்சலம்.ஜி (2009) இதயம் ஒரு கோவில், விஜயா பதிப்பகம்

Question Pattern	
காலம் : 3 மணி நேரம்	மொத்த மதிப்பெண்கள் : 75
பிரிவு – அ 10x1=10 • சரியான விடையைத் தேர்ந்தெடுத்து எழுதுக.	
பிரிவு – ஆ 5x5=25 • வணிகம் மற்றும் கணினித் தமிழ் - 1 வினா • ஊடகம் மற்றும் உளவியல் தமிழ் - 1 வினா • சுற்றுலாவியல் மற்றும் சுற்றுச்சூழலியல் - 1 வினா • மேலாண்மைத் தமிழ் மற்றும் மொழிப்பயிற்சி- 1 வினா • கொங்கு ஆளுமைகள் - 1 வினா	
பிரிவு – இ 5x8=40 • வணிகம் மற்றும் கணினித் தமிழ் - 1 வினா • ஊடகம் மற்றும் உளவியல் தமிழ் - 1 வினா • சுற்றுலாவியல் மற்றும் சுற்றுச்சூழலியல் - 1 வினா • மேலாண்மைத் தமிழ் மற்றும் மொழிப்பயிற்சி- 1 வினா • கொங்கு ஆளுமைகள் - 1 வினா	

குறிப்பு : ஆ, இ பிரிவுகளில் வினாக்கள் "இது" அல்லது "அது" என்ற வகையில் அந்தந்த அலகுகளிலிருந்து அமைத்தல் வேண்டும்.

Course Code	Course Name	Category	Hours / Week	Credits
24HIN31L	Hindi - III	Language - I	4	3

Course Objectives

The course intends to

- Have knowledge of the contents of primitive poetry
- Learn about contemporary poetry and its techniques.
- Interest in reading poetry and the ability to express social thoughts will improve
- Understand the basics of Hindi literature and to understand Hindi literature properly
- Have knowledge of the elements of poetry and the knowledge of subtle translation will improve

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	May have knowledge of the contents of primitive poetry	K1, K2
CLO2	Learn about contemporary poetry and its techniques.	K2
CLO3	Interest in reading poetry and the ability to express social thoughts will improve	K3
CLO4	This will help you to understand the basics of Hindi literature and to understand Hindi literature properly	K1, K3
CLO5	Knowledge of the elements of poetry and the knowledge of subtle translation will improve.	K2, K3
K1 - Remember; **K2** - Understand; **K3** - Apply		

Part – I: Hindi – III

Unit	Content	No. of Hours
I	**Poetry: Kavya Lehar – By Dr. V. Baskhar Pracheen Kavitha** 1. Mahatma Kaber – Saki 2. Goswamy Tulasidas – Ram-Van-Aman 3. Mahatma Soordas – Baal – Leela 4. Kavivar Rahim – Dohe	14
II	**Poetry: Kavya Lehar – By Dr. V. Baskhar Aadhunik Kavitha** 1. Mythili Sharn Gupth – Vikaral Bijali 2. Sumithranandan Panth – Parivarthan 3. Suryakanth Thripati Nirala – Sandhayasundarai 4. Ramdhari Sing Dinkar – Bhagavan Ke Dakkiya 5. Harivansray Bachchan – Kota Sikka 6. Agyeya – Anubhav Paripakva 7. Naresh Mehtha – Ullangan 8. Dharmaveer Bharathi – Tum Mere Koun Ho	14
III	**History of Hindi Literature:** (Sahithyik Tippanian) 1. Ammer Kusro 2. Vidhyapathi 3. Chandbardhayi 4. Pruthiviraj Raso 5. Ramacharitha Manas 6. Vinaya Patrika	12
IV	**Alankar:** 1.Anupras 2. Yamak 3. Slesh 4.Vakrokthi 5.Upama, 6. Roopak 7. Virodhabas	10
V	**Translation**: **English - Hindi only** Anuvadh abhyas – III (16-30 Lessons Only)	10
	Total Hours	**60**

Text Books	
1	Dr Baskhar V., (2006), Kavya ehar –Jawahar Pusthakalay, Sadar Bazaar,Mathura-U.P.281001.
2	Anuvadh Abyas-III,Dakshin Bharath Hindi Prachar Sabha Chennai – 17.
Reference Books	
1	Rajnath sharma,(2010) Hindi sahithya ka saral ithihaas, Vinod Pustak Mandir, Agra-282
2	Kavya pradeep rambadri shukla,(2008) hindi bhavan, 36, tagore town, allahabad – 211 002.

Course Code	Course Name	Category	Hours/Week	Credits
24MAL31L	Malayalam - III	Language - I	4	3

Course Objectives

The course intends to

- Have knowledge of the contents of primitive poetry
- Learn about contemporary poetry and its techniques.
- Interest in reading poetry and the ability to express social thoughts will improve
- Understand the basics of Malayalam Poetry and to understand Malayalam literature properly
- Provide knowledge of the elements of poetry.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Get a basic knowledge of the history of Malayalam literature.	K1
CLO2	Enhances the art and taste of Malayalam literary works	K1
CLO3	Literary genres can be learned	K2
CLO4	Create more to read and enjoy Malayalam poetry	K3
CLO5	Get the basic Knowledge of poetry techniques	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyse		

Part – I: Malayalam – III

Unit	Content	No. of Hours
I	Poetry – Chinthavishtayaya Seetha	14
II	Poetry – Chinthavishtayaya Seetha	14
III	Poetry – Mrugasikshakan - (Murgasikshakan, Kausalya, Varavu, Vittupoku Ekalavyan, Mazha) 6 poetries	12
IV	Poetry – Mrugasikshakan - (Kayal, Karkkadakam, Bhagavatham, Vazhivakkile naikutty, Edavelayil oru nimisham, Verumoru kathu) 6 poetries	10
V	Poetry – Aayisha	10
	Total Hours	**60**

Text Books	
1	Kumaranasan, (2012), Chinthavishtayaya Seetha, Kerala Book Store Publishers.
2	Vijayalakshmi, (2010), Mrugasikshakan, DC Books, Kottayam.
3	VayalarRamavarma,(2014), Aayisha, Kerala Book Store Publishers.
Reference Books	
1	Dr.Leelavathi M, (2015) Kavitha SahithyaCharitram, Kerala Sahithya Academy, Trichur.
2	Dr.Leelavathi M, (2015) Kavitha Dwani, D.C.Books, Kottayam.
3	Dr.George K.M, (2014) Aadhunika Sahithyacharithram Prasthanangalilude, D.C.Books, Kottayam.
4	Chummar T.M. (2009) Padya Sahithya Charithram, Kerala Sahithya Academy, Trichur.

Course Code	Course Name	Category	Hours/Week	Credits
24FRE31L	French - III	Language - I	4	3

Course Objective

The course intends

To interact in a simple way, ask and answer simple questions about themselves, where they live, people they know, and things they have, initiate and respond to simple statements in areas of immediate need or on very familiar topics, rather than relying purely on a very finite rehearsed, lexically-organized repertoire of situation-specific phrases.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Comprehend a repertoire of vocabulary	K1
CLO2	Understand tenses and intermediary level of grammar	K2
CLO3	Try to converse in unknown situation	K3
CLO4	Translate unknown texts on familiar topics	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyse		

Part – I: French – III

Unit	Content	No. of Hours
I	Etape 1 (Lecons 1 - 3)	14
II	Etape2 (Lecons 1 - 3)	14
III	Etape 3 - Leçons 1 – 2	12
IV	Etape 3 – Leçon 3	10
V	Etape 4 – Leçon 1	10

Text Book	
1.	Céline Himber, Corina Brillant, Sophie Erlich, (2014), Adomania2 – Methode Defrancais, Publisher: Hachette Fle
Reference Book	
1.	Yves Loiseau, Régine Merieux (2009), Latitudes 1, Publisher: French and European Publications Inc.
Total Hours	**60**

Course Code	Course Name	Category	Hours/ Week	Credits
24ENG32L	English-III	Language- II	4	3

Course Objectives

The course intends to cover

- Various genres of literature
- Inter personal skills essential at work environment

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	List out the connotations and denotations to pen poems.	K1
CLO2	Identify complex characters to navigate philosophical and intellectual learning and employ it in work place.	K2
CLO3	Interpret various prose styles to enhance creative writing	K3
CLO4	Compute vocabulary and grammatical proficiency in communication to enhance clarity in content creation.	K3
CLO5	Practice communication skills to be effective in lifelong learning.	K3
K1 – Remember; **K2**-Understand; **K3**- Apply		

Part-II: English-III

Unit	Content	No. of Hours
I	**Poetry** 1. Nothing Will Die – Alfred Lord Tennyson 2. Porphyria's Lover – Robert Browning 3. Obituary – A K Ramanujan	12
II	**Scenes from William Shakespeare's Plays** 1. Romeo and Juliet – The Balcony Scene 2. Merchant of Venice - Court Scene 3. Julius Caesar - Murder Scene	12
III	**Famous Speeches** 1. You've Got to Find What You Love-Steve Jobs 2. You Will Prevail -Sundar Pichai 3. I am Malala – Malala Yousafzai	12
IV	**Language Competency** 1. Identifying types of Sentences 2. Sentence Structure 3. Active Voice and Passive Voice 4. Direct and Indirect Speech	12
V	**English for Communication Listening and Speaking** Participating in a Group Discussion 1. Group discussion as a selection process 2. Different kinds of Group Discussion 3. Structure of Group Discussion 4. Successful Group Discussion Techniques 5. Group Discussion – Do's and Don'ts **Reading and Writing** 1. Reading diagrammatic information-interpretations maps, graphs and pie charts 2. Narrative writing– Two to three paragraphs 3. Dramatizing everyday situations/social issues through skits. (Writing scripts and performing)	12
	Total Hours	**60**
Reference Book		
1.	Wren, P.C. (1973). High school English grammar and composition.	
Web Resources (Swayam/NPTEL)		
1.	https://nptel.ac.in/courses/109106129	
2.	https://nptel.ac.in/courses/109104031	

Course Code	Course Name	Category	Hours/ Week	Credits
24BBT33C	Bioinstrumentation	Core – V	6	4

Course Objectives

The course intends to cover

- To understand the analytical techniques in the field of Biotechnology
- To understand the basic principles of Bioanalytical instruments.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Know the basics of instrumentation by analysis	K1
CLO2	Know the structure of atoms and molecules by using the principles of spectroscopy	K1
CLO3	Understand the Separating and Purifying the components	K2
CLO4	Categorize the working principle and applications of fluorescence and radiation based techniques	K2
CLO5	Understand the need and applications of imaging techniques	K2 , K3
K1 - Remember; **K2** – Understand; **K3**-Apply		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	3	2	2	3
CLO2	2	2	1	2	3
CLO3	3	2	2	3	3
CLO4	2	2	3	3	2
CLO5	1	1	2	2	2
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core – V: Bioinstrumentation

Unit	Content	No. of Hours
I	**Basics Instruments:** pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra. Types of microscopes- light, dark, phase contrast, fluorescent and electron microscope- (Transmission and Scanning electron).	18
II	**Spectroscopic Techniques:** Spectra – Absorption and Emission Spectra – Beer Lambert's law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance spectrometer (NMR).	18
III	**Chromatographic and Electrophoresis Techniques:** Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.	18
IV	**Fluorescence and Radiation Based Techniques:** Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.	18
V	**Imaging Techniques:** Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	18
	Total Hours	**90**
Text Books		
1.	Introductory Practical Biochemistry (2014), S. K. Sawhney and Randhir Singh. Narosa Publishing House	
2.	Principles of Applied Biomedical Instrumentation (2024), Gedder A and L. E. Balsar,John Wiley and Sons.	
Reference Books		
1.	Modern Experimental Biochemistry 2nd Edition (1993), Boyer, Rodney F.Benjamin and Cummins.	
2.	Biophysical Chemistry, Fourth Edition, (2020), Avinash Upadhyay, Himalaya publishing 'House.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc25_ph02/preview	

Course Code	Course Name	Category	Hours/Week	Credits
24BBT34C	Molecular Genetics	Core -VI	6	4

Course Objectives

The course intends to

- Focus on fundamental molecular genetics concepts.
- Understand the structure and processes involved in DNA and its conversion into proteins.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO statements	Knowledge Level
CLO1	Remember the concept of DNA and know the overview and scope of molecular genetics.	K1
CLO2	Understand the expression of the gene.	K1
CLO3	Understand the mechanism of translation.	K2
CLO4	Understand the mechanism of DNA damage and repair	K2
CLO5	Understand the mechanisms of recombination and mapping.	K2
K1 - Remember; **K2** – Understand.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	2	-	3	1
CLO2	3	2	-	2	2
CLO3	3	-	1	2	-
CLO4	3	3	-	3	1
CLO5	3	3	-	3	1
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core – VI: Molecular Genetics

Unit	Content	No. of Hours
I	**Introduction to Molecular Genetics:** Principles and applications of molecular genetics. Molecules of life. Structure, types and functions of DNA and RNA. DNA replication mechanisms steps and enzymes involved in replication.	18
II	**Gene Expression:** Transcription in Prokaryotes & Eukaryotes. Post transcriptional modification. Inhibitors of transcription. Regulation in Prokaryotes. Elucidation of genetic code.	18
III	**Translation:** Introduction to genetic code, Wobble hypothesis and its importance. Mechanism of translation in Prokaryotes & Eukaryotes. Inhibitors of protein synthesis. Post translational modifications and its importance.	18
IV	**DNA Damage and Repair:** DNA mutations and their mechanisms- Molecular basis of mutation. Spontaneous and induced mutations. Mutagens- Physical and chemical agents, Screening of chemicals for mutagenicity- Ames test. Types of repair mechanisms.	18
V	**Genetic Recombination:** Recombination- Homologous and non- homologous recombination, transposition, site specific recombination. Genetic exchange and their mapping.	18
	Total Hours	**90**
Text Books:		
1.	Dubey, R.C. (2014). A Textbook of Biotechnology. S Chand and Company, Ram Nagar, New Delhi 110 055 (India)	
2.	Satyanarayana, U and Chakrapani,U. (2020). Biotechnology. Books and Allied (P) Ltd	
Reference Books		
1.	David Freifelder. (2006). Molecular Biology. 15th edition. Narosa Publishing house, NewDelhi	
2.	Lodish, H, Berk, A, Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Martin K. (2016). Molecular Cell Biology, 8th Edition, Freeman and Company, New York.	
Web Resource (Swayam/NPTEL):		
1.	https://onlinecourses.nptel.ac.in/noc25_bt35/	

Course Code	Course Name	Category	Hours/ Week	Credits
24BBT35P	Bioinstrumentation & Molecular Genetics Lab	Core Lab – III	4	2

S. No.	List of Practicals	
1.	Preparation of Buffer- Phosphate.	
2.	Preparation of Buffer Acetate.	
3.	Preparation of Buffer Tris.	
4.	Determination of OD using pH.	
5.	Determination of OD using Colorimeter.	
6.	Determination of OD using Spectrophotometer.	
7.	Paper chromatography.	
8.	Thin Layer chromatography.	
9.	Agarose Gel Electrophoresis.	
10.	Isolation of genomic DNA from plant tissue.	
11.	Isolation of genomic DNA from animal tissue.	
12.	Isolation of genomic DNA from bacteria.	
13.	Quantification of Genomic DNA by diphenylamine reaction	
14.	Determination of absorption spectra of DNA using UV-Visible spectrophotometer	
15.	Separation of DNA by Agarose Gel electrophoresis.	
	Total Hours	**60**

Course Code	Course Name	Category	Hours/ Week	Credits
24BBT36A	Basics of Biopython	Allied-II	4	3

Course Objectives

The course intends to

- Develop the skills necessary for industry-oriented applications.
- Develop the basic skills required to retrieve, process, and visualize biological data from sequence and structure databases.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Basic architecture of digital computers and write simple Python programs using variables, data types, operators, and expressions.	K1
CLO2	Develop Python using conditional statements, loops, and user-defined functions for solving computational problems.	K1, K2
CLO3	Manipulate and analyze sequence data using Python string operations and list processing techniques.	K3
CLO4	Use tuples and dictionaries in Python to store, retrieve, and manage structured biological data efficiently.	K3
CLO5	Use Biopython tools to retrieve, process, and visualize biological data from sequence and structure databases.	K3
K1 - Remember; **K2** – Understand; **K3 –** Apply.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	1	2	2
CLO2	2	-	1	1	3
CLO3	1	-	-	-	3
CLO4	3	2	3	2	2
CLO5	2	2	1	2	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Allied – II: Basics of Biopython

Unit	Content	No. of Hours
I	**Introduction to digital computer :** Von Neumann concept- storage- Programming Languages – Translators- problem solving Strategies: Problem Analysis – Algorithms – Flow Charts – Introduction to Python: Introduction – Python overview- Comments-Python identifiers – Reserved Keywords – Variables – Standard data types – Operators- Statements and Expressions – String Operations- Boolean Expressions.	12
II	**Control Statements:** Iteration- The for loop – While statement – if elif else statement – Input from keyboard functions: Introduction- Built- in functions – Composition of functions – Type conversion – Data and time- dir () function – help () function – User defined functions – Parameters & arguments – Function calls – The return statement – Python recursive function – writing python scripts.	12
III	**Strings:** Compound data type – len function – String slice – String traversal – Escape characters – String formatting operator – String formatting functions. Lists – Values and accessing elements – Travering a list – Deleting elements from list- Built – in list operators – Built – in list methods.	12
IV	**Tuples:** Creating tuples – Accessing values in tuples – Tuple assignment – Tuples as return values- Basic tuples operations – Built in tuple functions- Dictionaries: Creating a dictionary – Accessing values in a dictionary – Updating dictionary – Deleting elements from dictionary – operations in dictionary – Built – in – dictionary methods.	12
V	**Introduction to Biopython:** Biopython Installation- Components: Alphabet-Seq-MutableSeq- SeqRecord-Align-AlighIO- ClustalW-SeqIO-AlignIO-BLAST-Biological Related Data-Entrez-PDB-PROSITE-SeqUtils-Sequencing. Visualisation : Visualizing DNA/protein sequences, alignments, or phylogenetic trees using matplotlib,seaborn etc.	12
	Total Hours	**60**
Text Books		
1.	E.Balagurusamy, (2016), Introduction to computing and Problem-Solving Using Python, McGraw Hill publication, New Delhi.	
2.	Sebastian Bassi, 2(2017), Python for Bioinformatics, CRC Press.	
Reference Books		
1.	Srinivasa K.G., Siddesh G.M.,Hanumantha Raju R., (2018). “Internet of Things” Cengage earning India pvt. Ltd	
2.	R.K. Taxali, PC Software for Windows Made Simple,Tata McGrawHill Publishing Company.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc25_bt21/	
2.	https://onlinecourses.nptel.ac.in/noc24_bt63/announcements?force=true	

Course Code	Course Name	Category	Hours / Week	Credits
24BBT37P	Cheminformatics	SEC-I	2	2

S. No.	List of Practical	
1.	Basics of Bioinformatics and its relation with molecular biology.	
2.	Introduction to Databases.	
3.	Examples of related tools (FASTA, BLAST)	
4.	Databases (GEO, BRENDA KEGG).	
5.	Databases (GENBANK, Pubmed, PDB)	
6.	Databases (UniProt), Gene structure Prediction.	
7.	Nucleic acid databases (NCBI, DDBJ, and EMBL), Primer tool.	
8.	Multiple sequence alignment and Patchdock.	
9.	Softwares used in molecular docking.	
10.	BIOLOGICS - drug discovery.	
11.	Preclinical Pharmacology & Taxology.	
12.	Cheminformatics tools for drug discovery.	
13.	Structural and Functional Genomics. Comparative Genomics.	
14.	Chemical databases: CSD, ACD, WDI, ChemBank, hazardous chemical database, PUBCHEM.	
15.	Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening.	
	Total Hours	**30**

Part – IV – Foundation Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Course Category	Hours/Week	Credits
24IKS3FC	Indian Knowledge Systems(IKS)	FC-III	-	2

Unit	Content
1	**Indian Knowledge Systems (IKS) Basic Concepts** - Introduction - Journey of Indian Culture and Civilization - Hindu Philosophical System - Contribution of Indian Knowledge System in Science and Arts - Indian Knowledge System and Way of Life - The Implicit Concepts in Indian Knowledge System - Social Viewpoint in Indian Knowledge system - Idea of Vasudhaiva Kutumbakam.
2	**Indian Culture, Art & Architecture** - Introduction - Concept of Culture - Culture and Heritage - General Characteristics of Culture - Indian Culture - Indian Culture during the Modern and Contemporary Period -The Factors of Unity in Diversity - Aspects of Indian culture - Indian Architecture - Architecture of Tamil Nadu.
3	**Vedic Mathematics** - Introduction - History of Vedic Mathematics - Addition - Subtraction - Base Method - Sub Base Method - Multiplication by numbers consisting of all 9s - Division - Special Methods of Division - Straight Division.
4	**Science and Technology in Indian Knowledge System** - Introduction - The Indian S & T Heritage - Metals and Metalworking Technology - Lost wax casting of Idols and Artefacts - Literary sources for Science and Technology - Technology in Ancient India - Significant Science and Technology Discovery in Ancient India - Council of Scientific and Industrial Research - Animal Science in Ancient India - Biodiversity and folk traditions.
5	**History of Trade and Commerce in Ancient India** - Introduction - Indigenous Banking System - Rise of Intermediaries - Transport - Major Trade Centres - Major Exports and Imports - Position of Indian Subcontinent in World Economy.
6	**Indigenous Agriculture in IKS** - Introduction - History of Indian Agriculture - Indigenous Knowledge - Organic Farming and Natural Fertilization - Mixed Cropping and

Unit	Content
	Crop Rotation - Ecological and Socioeconomic Impacts of Indigenous Farming - Challenges and Future Directions.
7	**Traditional Water Management Systems of India** - Introduction - Traditional Water Management Systems - Northern Region - North Western Region - North Eastern Region - Central Indian Region - Southern Indian Region.
8	**Traditional Foods and Festival of India** - History - Introduction - Foods Consumed in Different Regions of India - Eating Styles of India - Traditional Equipment's used for Cooking - Changes in Consumption of Traditional Foods - Traditional Foods/Modern Functions - The Future of Traditional Foods - Traditional Festivals of India.
9	**Sports in India-From Ancient Period to Modern Period** - Introduction - Indus Valley Civilization - Early Hindu Period/ Epic Period - Traditional Indoor and Outdoor Games - British Period - Post Independence - Modern period.
10	**Nobel Laureates of Indian Origin & Inspiring Scientists of India and their Contributions** - History of the Nobel Prize - Nobel Prize Insignia - Indian Nobel Prize winners and their Biography - Inspiring Scientists and their Contributions.

Reference Resources	
1.	https://www.education.gov.in/shikshakparv/docs/background_note_Stimulating_Indian_Knowledge_Systems_Arts_Culture.pdf
2.	Singh, R. K., King, C. A., & Barrett, D. A. (2010). Traditional ecological knowledge and agricultural sustainability in India. Indian Journal of Traditional Knowledge, 9(2), 231- 243

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA						
100	CIA	ESE	CIA		Model		Attendance	Active Engagement	Total
	25	75	Actual	Weightage	Actual	Weightage	5	5	25
			50	**5**	75	**10**			

Question Paper Pattern

Component	Duration in Hours	Section A			Section B			Section C			Total
		Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	
CIA	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / **ESE**	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA						
	CIA	ESE	Test		Model		Experiments / Programs	Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Marks	5	40
			50	**10**	60	**15**	**10**		

Examination Pattern

Component	Duration in Hours	Marks			Total Marks
		Practical Exam	Record	Weightage	
Test	2	50	-	**10**	50
Model	3	60	-	**15**	60
Experiments	-	-	-	**10**	10
Observation	-	-	-	**05**	05
Total Marks - CIA				**40**	**40**
ESE	3	50	10	-	**60**

Components for Internal Assessment and Distribution of Marks for CIA (Foundation Course -Theory)*

Max Marks	Marks for		Components for CIA				
50	CIA	ESE	CIA		Model		Total
	50	-	Actual	Weightage	Actual	Weightage	
			50	25	50	25	50

*FC-III - Indian Knowledge Systems – A self-study course with open book assessment

Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Offline	Open Choice	5 (Out of 8)	5 x 10=50

Components for and Distribution of Marks for ESE (Theory) Ability Enhancement Compulsory Courses (AECC) & Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Semester 4

Semester – 4									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours/ Week**	**Examination**				**Credits**
					Duration in Hours	**Max Marks**			
						CIA	**ESE**	**Total**	
24TAM41L	I	Language – I	Tamil – IV	4	3	25	75	100	3
24HIN41L	I		Hindi – IV						
24MAL41L	I		Malayalam – IV						
24FRE41L	I		French – IV						
24ENG42L	II	Language - II	English – IV	4	3	25	75	100	3
24BBT43C	III	Core Theory-VII	Recombinant DNA Technology	5	3	25	75	100	4
24BBT44P	III	Core Lab -IV	**Lab:**Recombinant DNA Technology	4	3	40	60	100	3
24BBT45A	III	Allied Theory III	Biostatistics	5	3	25	75	100	4
24BBT46P	III	Allied Lab - II	**Lab :** Basics of Bio Python	4	3	40	60	100	2
24BBT47P	IV	SEC Lab II:	**Lab:** Medical Coding	2	2	40	60	100	2
24IDT4AE/	IV	AECC IV	Innovation & Design T hinking/	2	2	-	50	50	2
24IPR4AE/			Intellectual Property Rights/						
24END4AE			Entrepreneurship Development						
24EXC4LA	IV	Extracurricular and co-curricular	Liberal Arts	-	2	50	-	50	2
Total				**30**				**800**	**25**

Part – I: Language – I

தமிழ் – IV

(All the UG Programmes)

Course Code	Course Name	Category	Hours / Week	Credits
24TAM41L	Tamil - IV	Language - I	4	3

Course Objectives

The Course intends to cover

- தமிழ் இலக்கிய வளர்ச்சிப் போக்குகள் மற்றும் நுட்பங்களை அறியச்செய்தல்.
- தமிழ்நாடு அரசுப் பணியாளர் தேர்வாணையம் நடத்தும் போட்டித்தேர்வுகளை எதிர்கொண்டு வேலைவாய்ப்பினைப் பெறும் வகையில் மாணவர்களைத் தயார்படுத்துதல்.
- கேட்டல், பேசுதல், படித்தல் மற்றும் எழுதுதல் முதலான திறன்களை(LSRW Skills) அறியச்செய்தல்.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	இலக்கியங்கள் மூலம் பண்டைய தமிழக மக்களின் வாழ்க்கை முறை, சமூக மதிப்பீடுகள், கலை, கலாச்சாரம் போன்றவற்றை ஆழமாகப் புரிந்துகொள்ளுதல்.	K1- K3
CLO2	தமிழறிஞர்களின் தமிழ்த்தொண்டை அறிவதன் மூலம் தமிழ் மொழியின் செழுமை, அதன் இலக்கிய வளம் மற்றும் பண்பாட்டு அடையாளம் ஆகியவற்றை அறிந்துகொள்ளுதல்.	K1- K3
CLO3	பிழையின்றி பேசுவதற்கும் எழுதுவதற்கும் இலக்கணத்தை பயன்படுத்துதல்.	K1 - K3
CLO4	தமிழ்நாடு அரசு நடத்தும் அனைத்து தேர்வுகளுக்கும் கல்வி மற்றும் மொழி வளர்ச்சிக்கும் கலைச்சொற்கள் ஒரு முக்கியத் தேவையாக உள்ளன என்பதனை உணர்தல்.	K1- K3
CLO5	உரைநடை பத்தியை வாசித்து கேட்கப்படும் வினாக்களுக்கு ஏற்ற பதில்களைத் தேடுவதன் மூலம் ஆழமான புரிதல் ஏற்படும் என்பதை உணர்தல்.	K2, K3
K1 - Remember; **K2** - Understand; **K3** – Apply		

Unit	Content	No. of Hours
I	**(இலக்கிய வரலாறு)** • திருக்குறள் • நாலடியார் • நான்மணிக்கடிகை • பழமொழி நானூறு • முதுமொழிக்காஞ்சி • திரிகடுகம் • இன்னா நாற்பது • சிறுபஞ்சமூலம் • ஏலாதி • ஔவையார் பாடல்கள்	12
II	**(தமிழ் அறிஞர்களும், தமிழ்த்தொண்டும்)** **திராவிட மொழிகள் தொடர்பான செய்திகள்:** • உ.வே.சாமிநாத ஐயர் • தெ.பொ.மீனாட்சி சுந்தரம் • சி.இலக்குவனார். **தமிழ்ப்பணி தொடர்பான செய்திகள்:** • தேவநேய பாவாணர் • பெருஞ்சித்திரனார் • ஜி.யு.போப் • வீரமாமுனிவர். **தமிழ்த்தொண்டு மற்றும் சான்றோர் தொடர்பான செய்திகள்:** • பாவேந்தர் • டி.கே.சிதம்பரனாதர் • தவத்திரு குன்றக்குடி அடிகளார் • கண்ணதாசன் • வேலுநாச்சியார் • முடியரசன் • தமிழ் ஒளி • கி.வா.ஜகந்நாதர் • நாமக்கல் கவிஞர்	12

Unit	Content	No. of Hours
III	**(இலக்கணம்)** • குறில், நெடில் வேறுபாடு • லகர, ளகர, ழகர வேறுபாடு • னகர, ணகர வேறுபாடு • ரகர, றகர வேறுபாடு • சுட்டெழுத்துக்கள் • வினா எழுத்துக்கள் • இனவெழுத்துக்கள் • ஒருமைப் பன்மை அறிதல் • எழுத்துப்பிழை, ஒற்றுப்பிழை அறிதல் • ஓரெழுத்து ஒருமொழி • ஒருபொருள் பன்மொழி • இருபொருள் குறிக்கும் சொற்கள்	12
IV	**(எழுத்துத்திறன் மற்றும் கலைச்சொற்கள்)** • சொற்றொடர் அமைத்தல் • தொடர் வகைகள் • செய்வினை, செயப்பாட்டு வினை • தன்வினை, பிறவினை. **திணைமரபு:** • உயர்திணை, • அஃறிணை. **பால் மரபு:** • ஆண்பால், • பெண்பால், • பலர்பால். • வினைமரபு • தொகை மரபு • நிறுத்தல் குறியீடுகள். **பல்துறை சார்ந்த கலைச்சொல்லுக்கு நேரான தமிழ்ச்சொல் அறிதல்:** • அறிவியல், கல்வி, மருத்துவம், மேலாண்மை, சட்டம், புவியியல், தொழில்நுட்பம், ஊடகம், தகவல் தொழில்நுட்பம்.	12

Unit	Content	No. of Hours
V	**வாசித்தல், புரிந்து கொள்ளும் திறன் மற்றும் எளிய மொழி பெயர்ப்பு** **வாசித்தல்** : கொடுக்கப்பட்ட பத்தியை வாசித்து கேட்கப்பட்ட வினாக்களுக்கு சரியான விடையைத் தேர்ந்தெடுத்தல். **புரிந்துகொள்ளும் திறன்:** உவமைத் தொடரின் பொருளறிதல், மரபுத்தொடரின் பொருளறிதல், பழமொழிகள் பொருளறிதல். **எளிய மொழி பெயர்ப்பு:** ஆங்கிலம் மற்றும் பிறமொழிச் சொற்களுக்கு இணையான தமிழ்ச் சொற்கள் அறிதல், பயன்பாட்டில் உள்ள ஆங்கிலச் சொற்களை மொழிபெயர்த்தல்.	12
	Total Hours	**60**

Reference Books

1	வரதராசன் மு. (2021, 34-வது பதிப்பு), தமிழ் இலக்கிய வரலாறு, சாகித்திய அகாதமி பதிப்பு.
2	டாக்டர் தமிழண்ணல், (2010, 26-ம் பதிப்பு), புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம்.
3	பேரா. முனைவர் பாக்கியமேரி, (2022, 6-ம் பதிப்பு), வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு, நியூசெஞ்சுரி புக் ஹவுஸ்(பி). லிட்.
4	பாலசுப்பிரமணியம் சி. (2016, 27-ம் பதிப்பு), தமிழ் இலக்கிய வரலாறு, சாரதா பதிப்பகம்.
5	டாக்டர் பூவண்ணன், (2019, முதல் பதிப்பு), தமிழ் இலக்கிய வரலாறு, வர்த்தமான் பதிப்பகம்
6	பேராசிரியர்.விமலானந்தம் மது.ச. (2017, முதல் பதிப்பு), தமிழ் இலக்கிய வரலாறு, பாரி நிலையம்
7	விஜயராகவன், முனைவர் கண்ணன் கு. (2018, முதல் பதிப்பு), தமிழ் இலக்கியம் இலக்கணம் வரலாறு, பாவை பப்ளிக்கேஷன்.
8	முனைவர் இராசா கி. (2019, 4-ம் பதிப்பு), தமிழ் இலக்கிய வரலாறு, நியூ செஞ்சுரி புக் ஹவுஸ் (பி). லிட்.
9	முனைவர் அருணாச்சலம் மு. (2017 6-ம் பதிப்பு), தமிழ் இலக்கிய வரலாறு, அருண் பதிப்பகம்.
10	குமரன் கோ (2010, முதல் பதிப்பு), தமிழ் இலக்கணம் எளிய அறிமுகம், சந்தியா பதிப்பகம்.

Part – I: Language – I
Hindi – IV

Course Code	Course Name	Category	Hours / Week	Credits
24HIN41L	Hindi – IV	Language - I	4	3

Course Objectives

The Course intends to cover

- Knowledge of contemporary drama contents of Hindi literature.
- Novels and its techniques. The ability to read novels and express criticism about it and the ability to express social thoughts will improve.
- Litigation messages in Hindi and news on speech techniques.
- The Ability to write articles on their own and improve their sophisticated translation skills.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the text styles and grammatical elements.	K1
CLO2	Discuss the content of a reading passage.	K2
CLO3	Develop an interest in the appreciation of short stories.	K3
CLO4	Comprehend the grammatical structures and sentence making.	K4
CLO5	Understand the language and developing English to Hindi translation skill.	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyse.		

Unit	Contents	No. of Hours
I	Drama: Dhuvasaminy By Jayashankar Prasad	12
II	Novel - Nirmala – Premchand	12
III	Lokkothi & Muhavare - Naveen Hindi Vyakaran (Selected Lokkokthi -10 & Muhavare-10)	12
IV	General Essay :Aadarsh Nibandh	12
V	Translation : Hindi-English Only Anuvadh Abhyas – III (16-30 Lessons Only)	12
	Total Hours	**60**
Text Books		
1.	Jayashankar Prasad (2015), Dhuvasaminy, Drama, , Publisher : Dakshin Bharath Hindi Prachar Sabha, Chennai-17.	
2	Premchand(2015),Nirmala,Novel , Rajkamal Prakashan,1B Nethaji Subash Marg,New Delhi	
Reference Books		
1.	Rajnath Sharma , Hindi Sahithya Ka Saral Ithihaas, , Vinod Pustak Mandir,Agra-282	
2.	Kavya Pradeep Rambadri Shukla, Hindi Bhavan, 36, Tagore Town, Allahabad – 211 002.	

Part – I: Language – I
Malayalam – IV

Course Code	Course Name	Category	Hours / Week	Credits
24MAL41L	Malayalam - IV	Language - I	4	3

Course Objectives

The Course intends to cover

- Knowledge of contemporary drama contents of Malayalam literature.
- Screen play and its techniques. The ability to read drama and express criticism about it and the ability to express social thoughts will improve.
- Litigation messages in Malayalam and news on speech techniques.
- Ability to write articles on their own and improve their creative skills.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Get a basic knowledge of drama	K1
CLO2	Can read and critique Screenplay	K1
CLO3	Create interest in art literature courses	K2
CLO4	The hope of writing a Drama or a Screen Play.	K3
CLO5	The idea of creating new works and critique knowledge will improve.	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyse.		

Unit	Content	No. of Hours
I	Screen Play – Perumthachan	12
II	Screenplay – Perumthachan	12
III	Drama – Saketham	12
IV	Drama – Saketham	12
V	Drama – Saaketham	12
	Total Hours	**60**

Text Books

1. Perumthachan – M.T.Vasudevan Nair, DC Books
2. Saketham – C.N.Sreekandan Nair, DC Books.

Reference Books

1. Malayala Nataka Sahithya Charithram. G Sankara Pillai (Kerala SahithyaAkademi, Trissur)
2. Malayala NatakaSahithya Charithram, Vayala Vasudevan Pillai (Kerala SahithyaAkademi Thrissur).
3. Natakam- Oru Patanam (C.J. SmarakaPrasanga Samithi, Koothattukulam)
4. Natakaroopacharcha, Kattumadam Narayanan (NBS, Kottayam)
5. Chalachithra sameeksha – Vijayakrishanan.
6. Cinemayude Paadangal Visakalanavum Veekshanavum – Jose-K.Manual

Part – I: Language – I
French – IV

Course Code	Course Name	Category	Hours / Week	Credits
24FRE41L	French – IV	Language - I	4	3

Course Objective

The Course intends

To communicate during easy or habitual tasks requiring a basic and direct information exchange on familiar subjects to use simple words to describe his or her surroundings and communicate immediate needs

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Comprehend the grammatical structures in various genres.	K1
CLO2	Understand the text styles and poetical elements.	K2
CLO3	Develop an interest in the appreciation of literature.	K3
CLO4	Discuss and respond to content of a reading passage.	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse		

Unit	Contents	No. of Hours
I	Etape 5 (Lecons 1 - 3)	12
II	Etape 6 (Lecons 1 - 3)	12
III	Etape 7 - Leçons 1 – 2	12
IV	Etape 7 – Leçon 3, Etape 8 – Leçon 1	12
V	Etape 8 – Leçons 2 – 3	12
Etapes 5 to 8, Pages 63 to 114		
	Total Hours	**60**
Text Book		
1	Adomania 2 , Methode de francais , Céline Himber, Corina Brillant, Sophie Erlich Publisher: HACHETTE FLE, Goyal Publishers and Distributors Pvt Ltd, New Delhi (9810322459)	
Reference Book		
1	Latitudes 1 , Yves Loiseau, Régine Merieux Publisher: French and European Publications Inc, Goyal publishers and distributors Pvt Ltd, New Delhi (9810322459).	

Part – II: English –IV
(All the Undergraduate Programmes)

English for Competitive Examinations

Course Code	Course Name	Category	Hours / Week	Credits
24ENG42L	English-IV	Language-II	4	3

Course Objectives

The course intends to cover

- Essential Language Skills for Competitive Exams.
- Grammatical Mastery and Writing Skills for confident formal communication.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Identify grammatical errors with precision and write with clarity and accuracy.	K1
CLO2	Identify, comprehend and use a wide range of vocabulary to enhance verbal expression.	K2, K3
CLO3	Construct structured essays, reports, and formal letters with clarity and coherence.	K3
CLO4	Interpret diverse texts using strategic reading techniques to analyze content and answer comprehension questions effectively	K3
CLO5	Understand and employ the technical and administrative terms to excel in the career.	K2, K3
K1 - Remember; **K2** - Understand; **K3** - Apply		

Part-II: English-IV

Unit	Content	No. of Hours
I	**Grammar** Parts of Speech, Concord, Tenses, Active Voice and Passive Voice, Types of Sentences – Statement, Interrogative, Imperative, Exclamatory, Transformation of Statements into imperatives, Interrogatives into Statements, Assertive into Negatives, Exclamatory Sentences into Statements, Imperatives into Inquisitive Interrogatives, Imperatives into Appreciative Statements, Verbs, Main Verbs and Auxiliary Verbs, Regular and Irregular Verbs	12
II	**Grammar** Infinitives, Gerunds, Participles, Question Tags, Sentence Patterns, Types of Sentences – Simple, Compound and Complex, Phrases and Clauses, Degrees of Comparison – Positive, Comparative & Superlative, Direct into Indirect and Indirect to Direct, Synthesis of Sentences, Punctuations,	12
III	**Vocabulary and Writing Skills** Synonyms, Antonyms, Homonyms, Homophones, Collocations, Idioms & Phrases, Phrasal verbs, Spelling of words, Correct usage of words, One word substitution, Word Creation, Singular and plural (including Zero plural), Derivatives, Abbreviations, British and American English, Compound words and Figures of speech. Letter writing (formal and informal) – Types of Letters, Precis Writing, Jumbled sentences, Finding out the right order of sentences, Making queries, Inferences, Blanks, Substitutions.	12
IV	**Reading Comprehension** Types of Passages (Narrative, Argumentative, Factual, Descriptive),Unseen passages (News Paper, Headlines, Editorials, Government related News), Question Types - Strong question, Weak question, Match the following, Sentence Completion, Ascertainment of facts	12
V	**Administrative Vocabulary & Translation** Marketing and Sales, Human Resource, Finance and Operation, Organization and Management, Office Procedures and Document Word Translation, Sentence Translation, Tense related translation tasks, Tense / Voice related tasks. (**Simple words - Basic Level**)	12
	Total Hours	**60**

Reference Books

1.	Bhatnagar, R. P., & Bhargava, R. (2017). English for Competitive Examinations (3rd ed.). New Delhi: Laxmi Publications.
2.	Wren, P. C., & Martin, H. (2007). High School English Grammar & Composition (11th ed.). New Delhi: S. Chand & Company
3.	Gupta, S. C. (2014). English Grammar & Composition (2nd ed.). Meerut: Arihant Publications
4.	Aggarwal, R. S., & Aggarwal, V. (2022). Quick Learning Objective General English (Revised ed.) New Delhi, S. Chand Publishing.

Web Resources (Swayam/NPTEL)

1.	https://onlinecourses.nptel.ac.in/noc24_hs73/preview

Course Code	Course Name	Category	Hours /Week	Credits
24BBT43C	Recombinant DNA Technology	Core Theory VII	5	4

Course Objectives

The course intends to cover

- The vectors, expression systems and methods of selection of genes.
- The importance of gene manipulation and gene transfer technologies and Hybridization technique.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Know the role of restriction and modifying enzymes in recombinant DNA technology.	K1
CLO2	Understand the tools and techniques in rDNA technology and types of Vectors.	K2
CLO3	Understand the molecular cloning strategies and techniques used to probe DNA for specific genes of interest.	K2
CLO4	Apply the techniques involved in construction of genomic DNA library and cDNA library.	K3
CLO5	Apply the protocols for analyzing gene transfer methods and to explore knowledge on hybridization-based markers	K3, K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	2	2	2	3
CLO3	1	2	3	3	3
CLO4	2	2	3	2	2
CLO5	2	2	2	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - III: Recombinant DNA Technology

Unit	Content	No. of Hours
I	**Introduction and importance of rDNA technology:** Tools in recombinant DNA technology. Restriction and Modification Systems of Bacteria. Restriction Enzyme, DNA Polymerases, RNA Polymerase, Taq Polymerase, DNA Ligase, Methylase, Polynucleotide Kinase, Alkaline Phosphatase, Reverse Transcriptase, DNaseI, S1nuclease, RnaseH, Terminal Deoxynucleotidyl Transferase.	15
II	**Vectors:** Molecular Biology of Lambda and Lambda Vectors, Cosmid Phagemid, M13. **Yeast Vectors:** YIP, YEP, YRP and YAC. Inducible Promoters, Selectable Markers and Expression Vectors.	15
III	**Plasmids:** Types of Plasmids (F, R and Col), Properties of Plasmid, Plasmid Compatibility, Copy Number Control. *E.Coli* Vectors- pBR322 and Their Derivatives, pUC Vectors and their Derivatives, BAC. Cloning In Bacillus and Streptomyces.	15
IV	**Viral vectors: Animal Vectors**: SV40 Vectors, Retero Viral and Baculo Viral Vectors, Shuttle Vectors. **Plant Vectors:** Ti Plasmid as Gene Vector, Caulimo Viruses, Gemini Viruses, Transposable Elements as Vectors Construction of cDNA and Genomic DNA Libraries.	15
V	**Probes and Techniques:** Probes - Probe Construction and Labelling. Introduction of Cloned Genes into Cell – Transformation, Transduction, Particle Bombardment, Liposome Mediation, Electroporation and Cocultivation. Identification of Recombinant DNA. Hybridization Techniques-Southern, Western and Northern Blotting, Chromosome Walking and Jumping. DNA Sequencing, Microarray. RFLP Maps, RAPD Markers, PCR, Antisense Technology, Terminator Gene Technology, DNA Finger Printing, CRISPER-Cas9.	15
	Total Hours	**75**

Text Books

1.	Primrose S.B. and Twyman R.M. (2016), Principles of gene manipulation and genomics. 7th edition, Blackwell publishing.
2.	Terry Brown (2007), Gene Cloning and DNA Analysis: An Introduction, 6th edition, A john Wiley & Sons Ltd.

Reference Books

1.	James. D. Watson (2001) Recombinant DNA technology, 2 nd edition, WH Freeman and company, New York.
2.	Genes to clones. Ernst. L. Winnacker, (2003), 2nd edition, Panima publishing corporation, NewDelhi.

Web Resources (Swayam / NPTEL)

1.	https://onlinecourses.nptel.ac.in/noc25_bt53/preview
2.	https://nptel.ac.in/courses/102103093

Course Code	Course Name	Category	Hours /Week	Credits
25BBT44P	**Lab: Recombinant DNA Technology**	**Core Lab - IV**	**4**	**3**

S. No.	List of Practicals	
1	Isolation of genomic DNA plant by CTAB method	
2	Isolation of plasmid DNA Bacteria.	
3	Isolation of RNA from Animal Tissue.	
4	Elution of DNA.	
5	Production of Competent cells for transformation.	
6	Bacterial transformation.	
7	Restriction digestion of DNA.	
8	Ligation.	
9	Western Blotting. (Demo)	
10	Southern Blotting. (Demo)	
11	PCR. (Demo)	
	Total Hours	**60**

Course Code	Course Name	Category	Hours / Week	Credits
24BBT45C	Bio Statistics	Allied – III	5	4

Course Objectives

The Course intends to cover

- The fundamental concepts and tools in Statistics with emphasis on their applications to statistical problems.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember that Statistics is used to collect, organize the data.	K1
CLO2	Understand the concept of dispersion and skewness and compare the spread and shape of data distributions.	K2
CLO3	Apply correlation and regression to examine relationships between variables and to predict future outcomes.	K3
CLO4	Apply the chi-square test to analyze categorical data and solve practical problems using its distribution.	K3
CLO5	Apply the F-test and ANOVA to compare group variances and find solutions to practical problems.	K3
K1 – Remember; **K2** - Understand; **K3** – Apply		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	3	2	1	3
CLO2	3	1	3	2	2
CLO3	3	3	2	1	3
CLO4	3	3	3	2	3
CLO5	2	3	2	1	2
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Allied - III: Bio Statistics

Unit	Content	No. of Hours
I	**Statistics:** Introduction to statistics -collection of data-primary and secondary-classification and tabulation -diagramatic and graphical presentation-measures of central tendency -mean, median, mode and simple problems.	15
II	**Measures of dispersion:** Range - quartile deviation - standard deviation - coefficient of variation and skewness-meaning -measures of skewness.-pearson's and Bowley's coefficient of skewness-kurtosis.	15
III	**Correlation**: Introduction to correlation -scatter diagram-Karl pearson's coefficient of correlation- Spearman's rank correlation- coefficient of concurrent deviation-regression analysis-meaning of regression and linear prediction-regression in two variables-uses of regression**.**	15
IV	**Chi-Square**: Introduction-Definition, degrees of freedom-The Chi-Square distribution-uses of chi Squre test-additive property of chi Square.	15
V	**F-Test and Applications of F test:** Analysis of variance-technique of analysis of variance-one-way classification model, two-way-classification model.	15
	Total Hours	**75**
Text Books		
1.	Navaneetham, P. A. (2022). Business Mathematics and Statistics. Trichy: Jai Publishers. Unit I : Page No:1-5,28-40,60-64,98-250 (Part II-Business Statistics) Unit II: Page No:301-310,325-373,396-415,424-428.(Part II-Business Statistics) Unit III: Page No:503-569(Part II-Business Statistics)	
2	Gupta, S. P. (2001). Statistical methods. New Delhi: Sultan Chand & Sons. Unit IV: Page No:954-970(Statistical Methods) Unit V:Page No:1006-1038(Statistical Methods)	
Reference Books		
1.	Hogg, R.V. &Craig. A.T.(1998) : Introduction to Mathematical Statistics, Macmillan	
2.	Mood. A.M. Graybill. F.A. & Boes, D.G. (1974): Introduction to Theory of Statistics, McGraw-Hill.	
Web Resources (Swayam / NPTEL)		
1.	https://archive.nptel.ac.in/courses/111/106/111106086/	

Course Code	Course Name	Category	Hours /Week	Credits
24BBT46P	Lab: Basics of Biopython	Allied Lab-II	4	2

S.No.	Programs
	Sample Programs – Basics of Python programs.
	Python Based Programs :
1	Calculate GC content in DNA sequence using input and output statements in Python
2	Check a Valid DNA sequence using if. else statement in Python
3	Palindrome DNA Check using slicing
4.	RNA Transcription To convert a given DNA sequence into its RNA sequence by replacing **T (Thymine)** with **U (Uracil)**.
5.	Count DNA Bases (A, T, G, C) and find Length
6.	Extract Subsequence (start–end positions)
7.	Find Motif in DNA & Motif Search
8.	Split DNA into Codons
9.	Codon Table Lookup (codon → amino acid) using Dictionaries in Python
10.	Count Amino Acids in Protein Sequence
	BioPython Programs :
1.	Read a DNA Sequence from FASTA File **Concepts used :**(loops, strings, built-in functions, objects)
2.	GC Content with Tuples **Concepts used**: tuple return values, len(), functions.
3.	Translate DNA into Protein & Store Codons in List **Concepts used**: lists, slicing, Biopython translate.
4.	Store Sequences in Dictionary & Search Motif **Concepts used**: dictionary operations, if-else.
5.	FASTA Reader with List of IDs **Concepts used:** SeqIO, list traversal.
6.	Protein Molecular Weight & Store in Dictionary **Concepts used**: dictionary, functions.
7.	Pairwise Alignment (loop over results) **Concepts used**: for loop, list indexing
8.	Visualization of Base Composition **Concepts used**: dictionary, matplotlib, list methods.
9.	Visualize Protein Lengths **Concepts used**: dictionary, list, seaborn plot.
10.	Reverse a Sequence **Concepts used**: recursion + Biopython Seq.

Course Code	Course Name	Category	Hours /Week	Credits
24BBT47P	Lab: Medical Coding	SEC Lab - II	2	2

S. No.	List of Practicals
1.	Introduction to Medical coding.
2.	ICD10: Coding of Infectious and parasitic diseases.
3.	Coding of Neoplasm, the blood and blood-forming organs and certain disorders.
4.	Mental, Behavioral and Neurodevelopmental disorders and Coding the diseases of the eye and adnexa.
5.	Coding the diseases of the ear and mastoid process. Coding the diseases of the circulatory system. Coding the diseases of the respiratory system.
6.	Coding the diseases of the digestive system. Coding the diseases of the skin and subcutaneous tissue. Coding the diseases of the musculoskeletal system and connective tissue.
7.	Coding the diseases of the genitourinary system. Coding of Pregnancy, childbirth and the puerperium. Certain conditions originating in the prenatal period. Coding of Congenital malformation.
8.	Coding of Symptoms, signs. · Injury, poisoning, other external causes, Factors influencing health statue contact with health services.
9.	CPT codes for Anesthesia, CPT codes for Radiology, CPT codes for Medicine.
10.	CPT codes for Pathology and laboratory. CPT codes for Surgery, Evaluation and management.
11.	HCPCS Level II.
12.	Coding Guidelines.
13.	Reimbursement or payment Methodologies.
	Total Hours **30**

Course Code	Course Name	Category	Hours / Week	Credits
24IDT4AE	**Innovation & Design Thinking**	**AECC - IV**	**2**	2

Course Objectives

The Course intends to cover

- The principles and practices of innovation and design thinking.
- Creative problem-solving skills, and impactful solutions across diverse contexts.
- The user-centered research techniques, and practical tools to generate, prototype.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the design thinking methodology for solving real-world problems.	K2
CLO2	Generate, prototype, and test innovative ideas.	K3
CLO3	Frame human-centered solutions and present them effectively.	K3
CLO4	Enhance their confidence in collaborative approaches to problem solving.	K3
CLO5	Integrate innovation strategies into business, social, and creative contexts to drive sustainable impact.	K4
K2 - Understand; **K3** – Apply ; **K4** - Evaluate		

Ability Enhancement Compulsory Courses (AECC)-IV : Innovation & Design Thinking

Unit	Content	No. of Hours
I	**Principles of Design Thinking:** Usability, Human-centeredness, Empathy, Iteration. **Types of Innovation:** Product, Process, Business Model, Social Innovation.	6
II	**Empathy & Defining The Problem:** Understanding users - observation - ethnographic research - interviews - Empathy maps and personas - Identifying user pain points - Problem framing vs. problem solving.	6
III	**Ideation & Creativity Tools:** Divergent vs. Convergent Thinking - Brainstorming and mind mapping techniques – SCAMPER. Idea selection and prioritization frameworks.	6
IV	**Prototyping & Experimentation:** Low-fidelity vs. High-fidelity prototyping - Storyboarding, sketching, mock-ups, and role-playing - Rapid prototyping with simple materials.	6
V	**Testing & Feedback:** Testing prototypes with users - Iteration and learning from feedback. **Innovation Strategy & Implementation :** Scaling ideas into innovations - Measuring innovation impact - Barriers - Design Thinking for social change and sustainability.	6
	Total Hours	**30**
Text Books		
1	Kelley, T., & Kelley, D. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.	
2	Dan Saffer, Designing for Interaction, New Riders Publications, 2010.	
Reference Books		
1	Plattner, H., Meinel, C., & Leifer, L. (Eds.). (2018). Design Thinking Research: Making Distinctions: Collaboration versus Cooperation. Springer.	
2	Liedtka, J., & Ogilvie, T. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia University Press.	
3	Martin, R. (2009). The Design of Business: Why Design Thinking Is the Next Competitive Advantage. Harvard Business Press.	
Web Resources (Swayam / NPTEL)		
1	https://onlinecourses.nptel.ac.in/noc22_mg32/preview	
2	https://onlinecourses.swayam2.ac.in/imb23_mg65/preview	
3	https://onlinecourses.nptel.ac.in/noc20_hs08/preview	

Course Code	Course Name	Category	Hours/Week	Credits
24IPR4AE	Intellectual Property Rights	AECC - IV	2	2

Course Objectives

This course intends to cover

- Identify the objectives, forms, duration, and scope of protection for different types of intellectual property.
- Understand the global IP framework and India's compliance challenges.
- Recognize the role of IP as a policy tool for national, economic, social, and cultural growth.
- Gain knowledge of substantive laws and procedural mechanisms of IP in India.
- Analyze recent national and global trends in intellectual property rights.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the core principles of intellectual property protection.	K1,K2
CLO2	Identify the key concepts and principles of trademarks.	K2
CLO3	Comprehend the legal implications and rights under copyright law.	K3
CLO4	Understand the legal consequences of patents and trade secrets.	K2
CLO5	Comprehend IP rights for plant varieties and farmers, along with their legal and social aspects.	K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyze		

Ability Enhancement Compulsory Courses(AECC)-IV : Intellectual Property Rights

Unit	Content	No. of Hours
I	**Introduction to Intellectual Property:** Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.	6
II	**Trade Marks:** Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.	6
III	**Law of Copy Rights:** Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law**.**	6
IV	**Law of Patents, Trade Secrets:** Foundation of patent law, patent searching process, ownership rights and transfer. Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.	6
V	**Protection of Plant Varieties and Farmers' Rights:** Introduction -Meaning and Definition - Registrable Varieties of Plants - Procedure for Registration - Plant Varieties Protection.	6
	Total Hours	**30**
Text Books		
1	V K Ahuja - Law Relating To Intellectual Property Rights - Lexis Nexis; Third Edition , 2017.	
2	Elizabeth Verkey - Intellectual Property Law and Practice – Eastern Book Company – 2018.	
3	S R Myneni - Law of Intellectual Property - Asia Law House – 2021.	
Reference Books		
1	B.L. Wadehra - Law Relating To Intellectual Property – Universal Law Publishing House, New Delhi , 2011.	
2	Avtar Singh - Intellectual Property Law - Eastern Book Company – 2015.	
Web Resources (Swayam/NPTEL)		
1	https://onlinecourses.nptel.ac.in/noc22_hs59/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24END4AE	Entrepreneurship Development	AECC – IV	2	2

Course Objectives

This course intends to cover

- Basics of starting and managing entrepreneurial ventures.
- Tools for planning, funding, and entrepreneurial growth.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the concept of entrepreneurship.	K2
CLO2	Gain knowledge on entrepreneurial motivation	K2
CLO3	Apply business idea evaluation	K3
CLO4	Create systematic Business plan	K3
CLO5	Analyse business finance and support	K4
K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyse		

Ability Enhancement Compulsory Course – IV : Entrepreneurship Development

Unit	Content	No. of Hours
I	**Entrepreneurship:** Meaning of Entrepreneurship - Characteristics, Functions and Types of entrepreneurs - Intrapreneur vs. Entrepreneur - Need for Entrepreneurship in economic development - Contribution to GDP, Employment, Innovation.	5
II	**Entrepreneurial Motivation:** Meaning - Need for Achievement Theory - Risk-taking Behaviour - Innovation and Entrepreneur – Economic & non-economic factors affecting entrepreneurial growth.	5
III	**Business Ideas:** Sources of Business Ideas & Opportunity Identification – Idea generation techniques (Brainstorming, Design Thinking). Business incubation - Technical Assistance for small business – Preparation of Feasibility Reports, Legal Formalities and Documentation	7
IV	**Business Plan:** Meaning and importance of Business Plan – Structure and components – Market Study.	7
V	**Entrepreneurial finance:** Sources of finance (Bank, Angel investors, Venture Capital, Crowdfunding, Mudra Loans) - Institutional support to entrepreneurs (DIC, KVIC, EDII and MSME).	6
	Total Hours	**30**
Text Books		
1	C.B. Gupta and N.P. Srinivasan (2020), Entrepreneurship Development, Sultan Chand and Sons.	
2	Dr. Vasant Desai and Dr. Kulveer Kaur (2021), Entrepreneurship Development and Management, Himalaya Publications.	
Reference Books		
1	Dr. Jayashree Suresh (2021), Entrepreneurial Publications, Margham Publications	
2	S S Khanka (2020), Entrepreneurial Development, Sultan Chand and Sons, New Delhi.	
Web Resources (Swayam/NPTEL)		
1	https://onlinecourses.nptel.ac.in/noc25_mg95/preview	

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA						
100	CIA	ESE	CIA		Model		Attendance	Active Engagement	Total
	25	75	Actual	Weightage	Actual	Weightage	5	5	25
			50	**5**	75	**10**			

Question Paper Pattern

Component	Duration in Hours	Section A			Section B			Section C			Total
		Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	
CIA	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / **ESE**	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA						
	CIA	ESE	Test		Model		Experiments / Programs	Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Marks	5	40
			50	**10**	60	**15**	**10**		

Examination Pattern

Component	Duration in Hours	Marks			Total Marks
		Practical Exam	Record	Weightage	
Test	2	50	-	**10**	50
Model	3	60	-	**15**	60
Experiments	-	-	-	**10**	10
Observation	-	-	-	**05**	05
			Total Marks - CIA	**40**	**40**
ESE	3	50	10	-	**60**

Components for and Distribution of Marks for ESE (Theory) Ability Enhancement Compulsory Courses (AECC) & Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Semester 5

Semester – 5									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours / Week**	**Examination**				**Credits**
					Duration in Hours	**Max. Marks**			
						CIA	**ESE**	**Total**	
24BBT51C	III	Core- VIII	Plant and Animal Biotechnology	5	3	25	75	100	4
24BBT52P	III	Core Lab-V	**Lab:** Plant and Animal Biotechnology	5	3	40	60	100	3
24BBT53C	III	Core - IX	Immunology	5	3	25	75	100	4
24BBT54P	III	Core Lab -VI	**Lab:** Immunology	5	3	40	60	100	3
24BBT55C	III	Core - X	Bioentrepreneurship	5	3	25	75	100	4
24BBT5AE	III	Elective – I	Nanobiotechnology (**Nanotechnology)**	5	3	25	75	100	3
24BBT5BE			Bioprocess Technology (**Industrial Biotechnology)**						
24BBT5CE			Bioethics and Biosafety **(Bioethics**)						
24BBT56I	III	SEC	Internship	-	2	50	-	50	2
Total				**30**				**650**	**23**

Course Code	Course Name	Category	Hours /Week	Credits
24BBT51C	Plant and Animal Biotechnology	Core- VIII	5	4

Course Objectives

The course intends to cover

- The fundamentals of tissue culture for propagation.
- The biotechnological applications of Plant, Animal tissue culture.
- The Plant and Animal product production and improvement.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the scientific and technical knowledge on plant tissue culture.	K1, K2
CLO2	Understand knowledge about the gene transfer techniques and applications.	K2
CLO3	Apply the knowledge in genetic engineering and gene modification in agriculture.	K3
CLO4	Apply the knowledge in animal cell culture methods for producing new varieties.	K3
CLO5	Apply and analyze the knowledge in maintenance of animal cells in culture.	K3, K4
K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	1	1	1	1
CLO3	1	2	3	3	3
CLO4	2	2	3	2	2
CLO5	2	2	2	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - VIII: Plant and Animal Biotechnology

Unit	Content	No. of Hours
I	**Cell and Tissue culture:** Introduction to Cell and Tissue Culture, Preparation Plant Tissue Culture Media (Composition, types), Plant Hormones and Growth Regulators in Tissue Culture, Preparations of Suitable Explants for Organogenesis. Micropropagation on Large Scale, Somatic Embryogenesis, Protoplast Culture and Somatic Hybridization, Anther, Pollen, and Ovary Culture for Production of Haploid Plants. Synthetic Seed Production. Secondary Metabolite Production. Challenges of Endangered Medicinal Plants based on IKS.	15
II	**Cell Culture Methods**: Cell Culture Methods for the Secondary Metabolite Production, Somaclonal Variation and its Significance, Cryopreservation, Plant Transformation Techniques- Agrobacterium Mediated Gene Transfer- Mechanism of DNA Transfer, General Features of Ti and Ri Plasmids. Nematode and Pest Resistant Variety. Symbiotic Nitrogen Fixation in Rhizobia, nif gene.	15
III	**Animal Cell Cultures:** Culture Media – Composition and Preparation, Balanced Salt Solution and Simple Growth Medium. Role of CO2, Serum and Protein – Free Defined Media and their Applications. Culturing and Maintenance of Different Animal Cell Lines.	15
IV	**Transgenic Animals:** Method of Obtaining Transgenic Animals Using Fertilized Eggs and Embryonic Blastocyst Cell. Importance of Transgenic Animals**.** Increased Productivity of Domestic Animals- Improved and Desired Characters of Domestic Animals, Stem Cells and their Applications.	15
V	**Animal Cloning:** Transgenic Silkworms. Methods of Cloning in Animal System- Rat, Sheep, Pig. Importance of Cloning – Gene Therapy and Cell Mediated therapy. Ethical Issues in Animal Biotechnology. Transfection of Cells in Cell Culture- Animal Viral Vector for Transfection, Physical Methods of Transfection. HAT selection.	15
	Total Hours	**75**
Text Books		
1.	Chawla., (2020), Introduction to Plant Biotechnology, Oxford and IBH Publishers, 3rd Edition.	
2.	Bernard R. Glick., (2010), Molecular Biotechnology, Principle and applications of recombinant DNA technology 4th Edition.	
Reference Books		
1.	Singh B D., (2015), Plant Biotechnology, Kalyani Publishers.	
2.	Ranga M M., (2021), Animal Biotechnology, Agrobios. 3rd Edition.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc25_bt53/preview	
2.	https://nptel.ac.in/courses/102103093	

Course Code	Course Name	Category	Hours/Week	Credits
24BBT52P	**Lab: Plant and Animal Biotechnology**	**Core Lab – V**	**5**	**3**

S. No.	List of Practical's	
1	Plant tissue Culture Media Preparation & Sterilization Techniques.	
2	Callus Induction.	
3	Isolation of Plant Protoplast & Viability Test.	
4	Localization of Nucleus using Nuclear Stain.	
5	In vitro Germination of Seeds.	
6	Enzyme Assay.	
7	Embryo Culture.	
8	Somatic Embryogenesis.	
9	Preparation of Animal Tissue Culture Medium and Membrane Filtration.	
10	Preparation of Single Cell Suspension & Cell counting.	
11	Cell Viability Test.	
12	MTT Assay (Demo).	
13	Cryopreservation and Thawing (Demo).	
	Total Hours	**75**

Course Code	Course Name	Category	Hours /Week	Credits
24BBT53C	Immunology	Core – IX	5	4

Course Objectives

The course intends to cover

- The knowledge of defense mechanism.
- The concept of immunology, immunity, antigen, antibody, cells of immune system.
- The function and regulations of immunoglobulins.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the history of Immunology.	K1, K2
CLO2	Understand the concepts of Immunoglobulin/Antibodies	K2
CLO3	Understand the development of cells, antigen and antibody.	K2
CLO4	Understand the adverse effect of immune system including Allergy, hypersensitivity and autoimmunity	K2
CLO5	Apply basic techniques for identifying antigen antibody interactions	K3
K1 - Remember; **K2** - Understand; **K3** – Apply.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	1	1	2	3
CLO3	2	2	1	2	1
CLO4	2	2	3	2	2
CLO5	2	2	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - IX: Immunology

Unit	Content	No. of Hours
I	**Basics of Immunology and Immune System:** Introduction, Historical Development in Immunology. Immunity and Cell Mediated Response, Primary and Secondary Immune Response. Cells involved in Immune Response. Innate and Acquired Immunity. Mechanisms of Defense.	15
II	**Antigen and Antibody Process:** Hematopoiesis and Development of B and T lymphocytes. Immunoglobulin Gene Expression B-cell and T-cell Activation. MHC Molecules Response of B -cells to Antigens. Plasma Cells, Memory Cells. **Case Study:** Immune response created using medicinal plants based on IKS.	15
III	**Components of Immune Cells:** Antigen- Types and Classifications. Antibody Structure, Types, Properties and their Biological Functions, Poly Clonal Sera, Monoclonal Antibody. Primary and Secondary Lymphoid Organs- Thymus, Bone marrow, Lymph nodes and Spleen. Lymphocytes Traffic and Regulation. CD molecules.	15
IV	**Immunological Reaction and Disorders:** Complement- Activation and Regulation. Cytokines – Structure and Functions, Interferon and Interleukins. Immuno Regulation. Tolerance, Suppression, Autoimmunity and Hypersensitivity reactions. Primary and secondary immune deficiency disorders.	15
V	**Immunotechnology:** Transplantation, HLA typing, mechanism of graft rejection. Tumor immunology. Immunosurveillance mechanisms. Antigen- Antibody interactions. Immunodiffusion and Immunoelectrophoresis. Principle and Applications of RIA, ELISA, Fluorescent Antibody Techniques.	15
	Total Hours	**75**

Text Book

1.	Kuby. J., (2018), Immunology, WH Freeman, 8th Edition.

Reference Books

1.	Tizard., (2024), Veterinary Immunology, 11th Edition.
2.	Ivan M. Roitt., (2017), Immunology, John Wiley, 13th Edition.

Web Resources (Swayam / NPTEL)

1.	https://nptel.ac.in/courses/102105083

Course Code	Course Name	Category	Hours/Week	Credits
24BBT54P	Lab: Immunology	Core Lab – VI	5	3

S. No.	List of Practical's	
1	Separation of Serum and Plasma.	
2	WBC counting, RBC counting, Differential blood count.	
3	WIDAL.	
4	ASO.	
5	CRP.	
6	Single Radial Immunodiffusion.	
7	Double Immunodiffusion.	
8	Preparation of Anti bodies.	
9	Rocket Immunoelectrophoresis.	
10	Handling of Laboratory animals. (Demo)	
11	Skin test. (Demo)	
12	ELISA. (Demo)	
13	Problem solving in Pedigree analysis.	
	Total Hours	**75**

Course Code	Course Name	Category	Hours /Week	Credits
24BBT55C	Bioentrepreneurship	Core-X	5	4

Course Objectives

The course intends to cover

- The challenges of being a Bio entrepreneur and current global status of the Bio industry.
- The technical skills of Vermicomposting, Sericulture, Aquaponics, Mushroom cultivation and SCP Production.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the Basics of Bio entrepreneurship.	K1, K2
CLO2	Understand the Business plan preparation.	K2
CLO3	Apply the knowledge in vermicomposting and sericulture.	K2
CLO4	Apply the knowledge in mushroom cultivation.	K3
CLO5	Apply the knowledge in Single Cell Protein Production.	K3
K1 - Remember; **K2** - Understand; **K3** – Apply.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	2	2	2	3
CLO3	1	2	3	3	3
CLO4	2	2	3	2	2
CLO5	2	2	2	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core - X: Bioentrepreneurship

Unit	Content	No. of Hours
I	**Basics of Bioentrepreneurship**: Biotechnology in a Global scale; types of Bio-industries – Biopharma, Bioagri and Bio Service Innovations –Successful Entrepreneur – Creativity, Leadership, Managerial skills, Team building, Decision making; Public and Private Funding Agencies (MSME, DBT, BIRAC, Startup & Make in India)	15
II	**Business plan preparation:** Business Feasibility analysis by SWOT, Business Plan Proposal for Virtual Startup Company, Statutory and Legal Requirements for Starting a Company/Venture. **Basics in Accounting Practices**. Market Conditions, Identifying the need of the Customers.	15
III	**Vermicomposting and Sericulture:** Earth Worms-Ecological Types-Vermiculture-Compost Pit-Vermi Bed-Applications. Sericulture- Mulberry Cultivation-Silkworm Rearing-Economics of silkworm Production- Chawki Rearing-Sericulture in India.	15
IV	**Phases of Mushroom Cultivation:** Selection of an Acceptable Mushroom Species/Strains, Management of Mushroom Development, Mushroom Harvesting, Mushroom Diseases, Medicinal and Nutritional Properties of Mushroom. **Aquaponics:** Systems-Fish and Vegetables-Nutrients and Biofilters-Advantages and Disadvantages.	15
V	**Single Cell Protein Production:** Source: Algae, Bacteria, Yeast – Cultivation of Single Cell protein: Spirulina Cultivation – Production site, Microorganism, **Experimental Design**: Harvesting and Drying.	15
	Total Hours	**75**
Text Book		
1.	Craig Shimasaki, 2014, "Biotechnology Entrepreneurship Starting, Managing, and Leading Biotech Companies", Academic Press (Imprint of Elsevier).	
Reference Books		
1.	Jordan, J. F., (2014), Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.	
2.	Shimasaki, C. D., (2020), Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.	
Web Resources (Swayam / NPTEL)		
1.	https://nptel.ac.in/courses/109106128	

Course Code	Course Name	Category	Hours /Week	Credits
24BBT5AE	Nanobiotechnology	Elective-I	5	3

Course Objectives

The course intends to cover

- The concept of Nanobiotechnology and its characteristics.
- The latest trends of Nanobioparticles.
- The drug design and delivery in nanotechnology.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the concepts of Nanobiotechnology.	K1, K2
CLO2	Understand the techniques of nanobiotechnology and protein folding.	K2
CLO3	Understand the functional concepts of biomaterials.	K2
CLO4	Apply the knowledge in, microarray technology, Nanobiosensors, and Biochips.	K3
CLO5	Apply and analyze the knowledge in drug delivery system and cancer biology.	K3,K4
K1 - Remember; **K2** - Understand; **K3** – Apply; K4-Analyze.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	2	2	2	3
CLO3	1	2	3	3	3
CLO4	2	2	3	2	2
CLO5	2	2	2	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective - I: Nanobiotechnology

Unit	Content	No. of Hours
I	**Introduction to Nanotechnology:** Key features of Nano-size, size determination - XRD and Particle size analyzer. Comparison of particle behavior at nano size to macro size. Strategies for Nanoarchitecture (top down & bottom-up approaches). **Introduction to Nanobiotechnology:** Biogenic nanoparticle synthesis from plants, bacteria and yeast. Biomolecular design.	15
II	**Structural Principles of Nanobiotechnology:** Natural Bionanomachinery – (Lotus leaf effect, Gecko lizard, Fish Hair Structures, Butterfly wings). Overview of Nanodevices - Strategies for construction of Nanodevices using Carbon as a Raw Material. **Protein Folding Aspects:** Stable Structure, Globular Proteins, Role of Chaperones in Folding, Lipid Bilayer, DNA Based Nanostructures.	15
III	**Functional Nanobiotechnology:** Principles of Functional Nanobiotechnology. Information-Driven Nanoassembly, Energetics; Biomaterials- Filaments and fibrils, Minerals combined with Biomaterials for Specific Applications. IKS-Based Biomaterials for Tissue Engineering. Biomolecular sensing taste and light sensors. Machine phase Nanobiotechnology- Muscle sarcomeres and Nerves.	15
IV	**Clinical Based Nanobiotechnology**: Differentiation of Nanoparticles and Nanosystems. Conventional drug delivery & Targeted Drug Delivery its Role and Advantages; Clinical Trials Involved in Nanobiotechnology.	15
V	**Applications of Nanobiotechnology:** Principles, Types and Applications of Bionano-Imaging, Magnetic Nano-Particles, Nano-Biosensors, Biochips, Biorobotics, Nanopore Technology and Nanoarrays in Medicine, Agriculture, Food and Environmental Science. Role of AI in Nanobiotechnology. Opportunities and challenges of Nanotechnology.	15
	Total Hours	**75**

Text Book

1.	Shanmugam.S., (2010), Nanotechnology, MJP publishers.

Reference Books

1.	Niemeyer, C.M. and Mirkin, C.A. 2004. Nanobiotechnology: Concepts, Applications and Perspectives. 1st Edition. Wiley-VCH, Germany.
2.	Vasantha Pattabhi and Gautham N., (2009), Biophysics, Narosa Publishmg House, New Delhi.

Web Resources (Swayam / NPTEL)

1.	https://nptel.ac.in/courses/108106186

Course Code	Course Name	Category	Hours /Week	Credits
24BBT5BE	Bioprocess Technology	Elective-I	5	3

Course Objectives

The course intends to cover

- The fundamentals of bioprocess technology.
- The upstream and downstream processing in fermentation technology.
- The applications of recovery and purification of fermented products in food and pharma industries.

Course Learning Outcomes

On the successful completion of the course, the students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the fundamentals of bioprocess technology.	K1& K2
CLO2	Understand the design of various types of fermenters.	K2
CLO3	Understand media components and its optimization in bioprocess technology.	K2
CLO4	Apply the knowledge on recovery and purification of fermentation products.	K3
CLO5	Apply the bioprocess technology in food and pharma industries.	K3
K1 - Remember; **K2** - Understand; **K3** – Apply.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	2	2	2	3
CLO3	1	2	3	3	3
CLO4	2	2	3	1	2
CLO5	2	2	2	1	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective-I: Bioprocess Technology

Unit	Content	No. of Hours
I	**Overview of Bioprocess Technology and its Significance**: Basics of Fermentation, Types of Fermentation – Microbial Fermentation Methods – Solid State Fermentation – Submerged Fermentation (Batch, Fed -Batch & Continuous). Isolation – Screening – Primary and Secondary Screening, Methods and Maintenance of Industrially Important Microbes. Strain Improvement Methods.	15
II	**Design of a Fermenter:** Basic Architecture and Functions of a Fermenter. Control parameters – Automation in Fermentation Technology. Types of Fermenter – Batch Bioreactor – Stirred Type Bioreactors – Airlift Bioreactors – Fluidized Bed reactor – Packed Bed Reactor – Bubble Column Bioreactor.	15
III	**Media for Industrial Fermentation:** Sterilization of Media – Criteria for Fermentation Media – Media Components – Water, Carbon Sources, Nitrogen Sources, Minerals, Buffers, Chelators, Precursors, Inducers, Antifoams and Trace Elements. Inoculum for Fermentation.	15
IV	**Recovery and Purification of Fermentation Products**: Removal of Microbial Cell and other Solid Matters – Precipitation – Filtration – Centrifugation – Cell Disruption – Physio and Chemical Methods. **Chromatography**: Adsorption, Ion Exchange, Gel Permeation, Affinity – High Performance Liquid Chromatography – Drying- Quality Assessment & Packaging.	15
V	**Fermentation Applications in Industry**: Organic acids (Citric acid)- Amino acid (L-Glutamic acid) – Brewing (Beer and Wine)- Antibiotic production (Ampicillin) – Vitamin (B12), Solvent (Ethyl alcohol), Enzyme production, Biofertilizers, Biopesticides, Biopolymer, Recombinant Protein Production (Peptide vaccine).	15
	Total Hours	**75**
Text Book		
1.	Stanbury P F & Whitaker A., (2016), Principles of Fermentation Technology, Oxford: Pergamon Press.	
Reference Books		
1.	EI-Mansi M & Bryce C F (2020), Fermantaion Microbiology and Biotechnology, Boca Raton: CRC/ Taylor & Francis, 4th Edition.	
2.	Rao D G, 2010, Introduction to Biochemical Engineering, Mc Graw- Hill publications, 1st Edition.	
Web Resources (Swayam / NPTEL)		
1.	https://nptel.ac.in/courses/102105100	

Course Code	Course Name	Category	Hours /Week	Credits
24BBT5CE	Bioethics and Biosafety	Elective-I	5	3

Course Objectives

The course intends to cover

- The human rights and ethical issues related to biotechnological experiments.
- The knowledge on Intellectual Property Right, and Good Manufacturing Practices.

Course Learning Outcomes

On the successful completion of the course, the students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the human rights and its Acts.	K1, K2
CLO2	Understand the Impact of gene cloning & Bioethics.	K2
CLO3	Understand Bioethics of IPRs	K2
CLO4	Apply for Patent and copyright.	K3
CLO5	Apply the knowledge in GMOs.	K3
K1 - Remember; **K2** - Understand; **K3** – Apply.		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	1	1
CLO2	1	2	2	2	3
CLO3	1	2	3	3	3
CLO4	3	2	3	3	2
CLO5	2	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective-I: Bioethics and Biosafety

Unit	Content	No. of Hours
I	**Human Rights:** Definition, Classification and Scope of Human Rights. United Nations Commission for Human Rights, National and State Human Rights Commission. Article 21 of Indian Constitution – UDHR. Social issues of Human rights.	15
II	**Impact of Gene Cloning & Bioethics**: Issues Concerning Reproduction, Birth, life and Death Related to Artificial Insemination, Egg Donation, IVF, Embryo Transplants, Prenatal Diagnosis and Sex Selection & Abortion.	15
III	**Bioethics of IPR:** Ethical Criteria in Biotechnology- Animal Ethics; Licensing of Animal House - Human Cloning - Ethical Issues - Ethical Clearance Norms for Conducting Studies on Human, Animals, and Zebra fish Subjects.	15
IV	**Patents:** Introduction -Treaties and Conventions of Patents, Patent Cooperation Treaty - TRIPS Basis of Patentability - Nonpatentable Inventions - Patent Application Procedure in India. **Other Forms of IP**: Copyright - Trade Mark – Industrial Designs – Farmer's Rights. Patenting of Biotechnology Products and Processes.	15
V	**Biosafety:** General guidelines - DBT Guidelines on Biosafety in Conducting Research in Biology / Biotechnology - Risk Assessment Studies- Hazardous Materials used in Biotechnology- Handling and Disposal - Good Manufacturing Practices & Good Laboratory practices, Containment Facilities and Biosafety Practices - Regulation on Field Experiments and Release of GMO's - Labelling of GM foods - Guidelines for Research in Transgenic Plants and Animals.	15
	Total Hours	**75**
Text Book		
1.	V. Sree Krishna . V (2007), Bioethics and Biosafety in Biotechnology, New Age International Private Limited. 1st Edition.	
Reference Books		
1.	Rhona Smith., (2007), International Human rights, Blackstone Press.	
2.	John. A. Thomas., (2004), Biotechnology and safety assessment. pp.333	
Web Resources (Swayam / NPTEL)		
1.	https://nptel.ac.in/courses/102103093	

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA						
100	CIA	ESE	CIA		Model		Attendance	Active Engagement	Total
	25	75	Actual	Weightage	Actual	Weightage	5	5	25
			50	5	75	10			

Question Paper Pattern

Component	Duration in Hours	Section A			Section B			Section C			Total
		Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	
CIA	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / **ESE**	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA						
	CIA	ESE	Test		Model		Experiments / Programs	Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Marks	5	40
			50	10	60	15	10		

Examination Pattern

Component	Duration in Hours	Marks			Weightage
		Practical Exam	Record	Total Marks	
Test	2	50	-	**50**	10
Model	3	60	-	**60**	15
Experiments Completed	-	-	-	**10**	10
Observation Note	-	-	-	**05**	05
				Total Marks - CIA	**40**
ESE	3	50	10	-	**60**

Components for Internal Assessment and Distribution of Marks for CIA (Foundation Course -Theory)

Max Marks	Marks for		Components for CIA				
50	CIA	ESE	CIA		Model		Total
	50	-	Actual	Weightage	Actual	Weightage	
			50	**25**	50	**25**	**50**

Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Offline	Open Choice	5 (Out of 8)	5 x 10=50

Components for and Distribution of Marks for ESE (Theory) Ability Enhancement Compulsory Courses (AECC) & Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Components of Internship (Internal Assessment Only)

Components	Marks
Submission of Internship Report	20
Performance in viva-voce	30
Total Marks	**50**

***Certification of Completion is Mandatory for the award of Internal Marks and to avail the credits**