SRI VENKATESWARA COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University, Chennai - 600025)

REGULATIONS 2022

B. TECH. BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION

To produce higher caliber Biotechnologists to attain new heights in bioinformatics and bioprocess technology as per industrial needs and to provide leaders in the field of Biotechnology.

MISSION

1. To progress the department to attain center of excellence in bioinformatics and bioprocess technologies by providing best Undergraduate, Postgraduate, Doctoral programs and R&D activities within a decade.
2. To develop special skilled training programs for graduates to meet the personality characters stipulated by the industries within a period of five years.
3. To build potential biotechnologists capable of dealing with new challenges and socio-ethical implications.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To produce Biotechnology graduates who will be employable in core Biotech/Pharma industries and domain based software services.
2. To produce research oriented Biotechnology graduates who will be employable in academic/Industry sponsored research and also who will be pursuing higher studies.
3. To produce bio-entrepreneurs.

PROGRAM OUTCOMES (POs)

PO   GRADUATE ATTRIBUTES

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering

problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To make the students understand and apply the knowledge of computational systems biotechnology to design and develop biologics to meet societal needs.

2. To train the students to meet the requirement of bioprocess industries for developing techno economical processes.

3. To empower the students with competent skill sets for bridging the gap between academia and the requirements of the healthcare industry.

PEO's–PO's & PSO's MAPPING:

POs	PEOs		
	1	2	3
1	✓		
2		✓	
3			✓
4		✓	✓
5	✓	✓	
6		✓	✓
7		✓	
8		✓	
9			✓
10		✓	
11		✓	
12	✓		
PSO 1			✓
PSO 2	✓		
PSO 3		✓	✓

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REGULATIONS 2022

B. TECH BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM
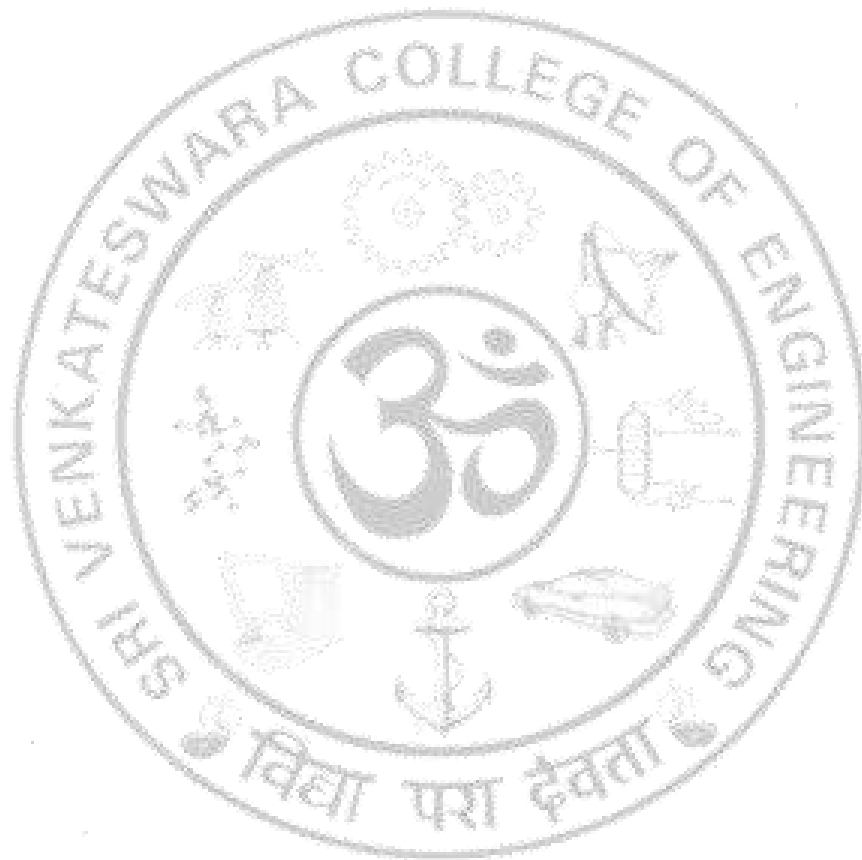
CURRICULUM & SYLLABI FOR SEMESTERS I-IV

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
1.	IP22151	Induction Programme (Common to all Branches)	-	-	-	-	-	-	-	-
Theory Courses										
2.	HS22151	Tamil Language and Heritage of Ancient Tamil Society (Common to all Branches)	HS	1	0	0	1	1	Nil	F
3.	HS22152	Communicative English (Common to all Branches)	HS	3	0	0	3	3	Nil	F
4.	MA22151	Applied Mathematics I (Common to all Branches except MR)	BS	3	1	0	4	4	Nil	F
5.	PH22153	Technical Physics (Common to BT, CH)	BS	3	0	0	3	3	Nil	F
6.	CY22153	Technical Chemistry	BS	3	0	0	3	3	Nil	F

#	Code	Title	Cat							
		(Common to BT, CH, CE)								
7.	ME22151	Engineering Graphics (Common to BT, CH)	ES	2	0	2	3	4	Nil	F
8.	ME22152	Basic Mechanical Engineering (Common to BT, CH)	ES	3	0	0	3	3	Nil	F
9.	BT22101	Biology for Engineers (Common to BT, AE, IT)	ES	3	0	0	3	3	Nil	F
Practical Courses										
10.	CY22161	Chemistry Laboratory (Common to all Branches except AD, CS, IT)	BS	0	0	2	1	2	Nil	F
11.	ME22162	Basic Mechanical Engineering Laboratory (Common to AE, BT, CH)	ES	0	0	2	1	2	Nil	F
		Total		**21**	**1**	**6**	**25**	**28**	-	-

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	HS22251	Science and Technology in Ancient Tamil Society (Common to all Branches)	HS	2	0	0	2	2	Nil	F
2.	HS22252	Technical English (Common to all Branches)	HS	3	0	0	3	3	Nil	F
3.	MA22251	Applied Mathematics II (Common to all Branches except MR)	BS	3	1	0	4	4	Nil	F
4.	PH22251	Physics for Biotechnologists	BS	2	0	2	3	4	Nil	F
5.	EE22151	Basic Electrical and Electronics Engineering (Common to all Branches except CH, EE, EC)	ES	3	0	0	3	3	Nil	F
6.	IT22251	Computer Programming and Practice (Common to AE, BT, CH, CE)	ES	2	0	2	3	4	Nil	F
7.	BT22201	Bioorganic Chemistry	PC	3	0	0	3	3	Nil	F
Practical Courses										
8.	EE22111	Basic Electrical	ES	0	0	2	1	2	Nil	F

		and Electronics Engineering Laboratory (Common to all Branches except EC)								
9.	BT22211	Bioorganic Chemistry Laboratory	PC	0	0	4	2	4	Nil	F
Total				**18**	**1**	**10**	**24**	**29**	-	-

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	MA22355	Partial Differential Equations and Numerical Methods (Common to AE, BT and MN)	BS	3	1	0	4	4	Nil	F
2.	BT22301	Stoichiometry and Process Calculations	ES	2	1	0	3	3	Nil	F
3.	BT22302	Microbiology	PC	3	0	0	3	3	Nil	F
4.	BT22303	Biochemistry	PC	3	0	0	3	3	Nil	F
5.	BT22308	Basic Industrial Biotechnology: Theory and Practices	PC	2	0	2	3	4	Nil	M
6.	BT22309	Cell Biology: Theory and Practices	PC	2	0	2	3	4	Nil	M
Practical Courses										
7.	BT22311	Microbiology Laboratory	PC	0	0	4	2	4	Nil	F
8.	BT22312	Biochemistry Laboratory	PC	0	0	4	2	4	Nil	F
		Total		15	2	12	23	29	-	-

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK				TOTAL HOURS	PREREQUISITES	POSITION
				L	T	P	C			
Theory Courses										
1.	MA22451	Introduction to Biostatistics	BS	3	1	0	4	4	Nil	F
2.	GE22451	Environmental Sciences and Sustainability (Common to all Branches)	BS	3	0	0	3	3	Nil	F
3.	BT22401	Analytical Techniques and Instrumentation	ES	3	0	0	3	3	Nil	M
4.	BT22402	Transport Phenomena of Bioprocesses	PC	2	1	0	3	3	Nil	F
5.	BT22403	Chemical and Biochemical Thermodynamics	PC	3	0	0	3	3	Nil	M
6.	BT22404	Genetics and Molecular Biology	PC	3	0	0	3	3	Nil	F
Practical Courses										
7.	BT22411	Analytical Techniques and Instrumentation Laboratory	ES	0	0	4	2	4	Nil	F
8.	BT22412	Chemical Engineering	PC	0	0	4	2	4	Nil	F

		Laboratory								-	-
		Total		**17**	**2**	**12**	**23**	**27**		-	-
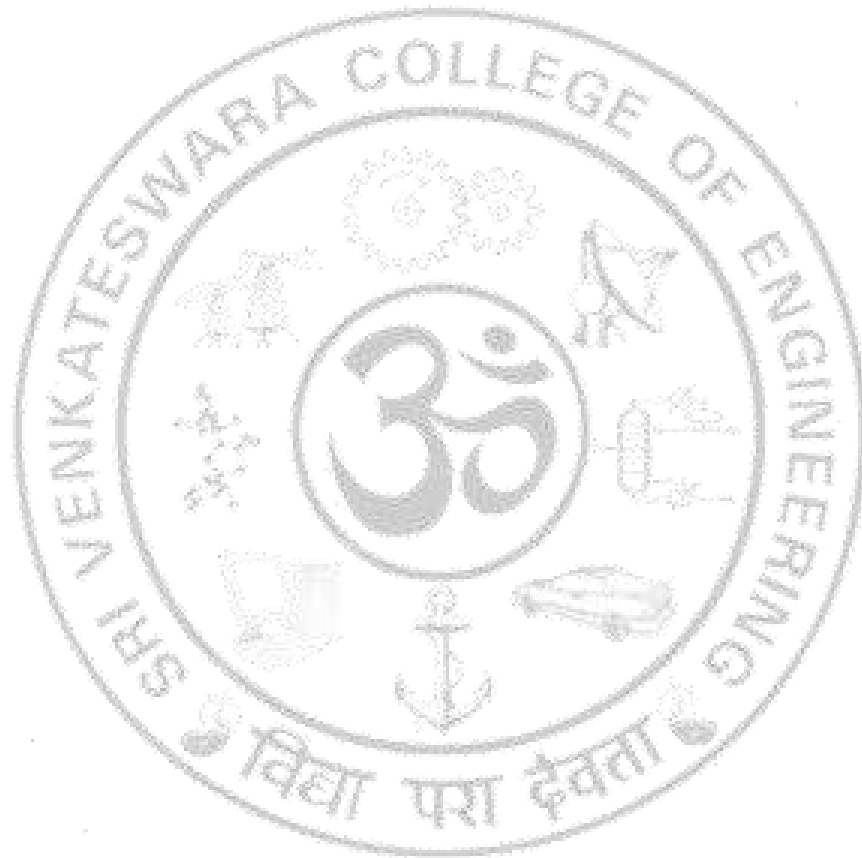
		L	T	P	C
HS22151	தமிழ் மொழியும் தமிழர் மரபும் **TAMIL LANGUAGE AND HERITAGE OF ANCIENT TAMIL SOCIETY** **(Common to all branches)**	1	0	0	1

பாடத்தின் நோக்கங்கள்:

1. தமிழ் மொழியின் தோற்றம் பற்றியும், திணைகருத்துக்கள் வாயிலாக வாழ்வியல் முறைகளை பற்றியும் கற்றுக் கொள்வார்கள்

2. இந்திய தேசிய சுதந்திர இயக்கத்தில் தமிழர்களின் பங்களிப்பு மற்றும் தமிழர்களின் மேலாண்மை முறைகளை பற்றியும் கற்றுக் கொள்வார்கள்.

OBJECTIVES:

1. To learn about the origin of the Tamil language and the ways of life through five types of lands.

2. To learn about the contribution of Tamils in the Indian National Freedom Movement and the management methods of Tamils.

அலகு 1	**தமிழுக்கும் தொழில்நுட்ப கல்விக்கும் உள்ள தொடர்பு**	**3**

மொழி மற்றும் பாரம்பரியம் : இந்தியாவில் உள்ள மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழில் செம்மொழி இலக்கியம் - உ.வே. சுவாமிநாத ஐயர்., ஆறுமுக நாவலர் ஆகியோரின் பங்களிப்பு - தொழில்நுட்ப கல்வியில் தமிழ் மொழிக் கல்வியின் முக்கியத்துவம்.

UNIT I	**LANGUAGE AND HERITAGE**	**3**

LANGUAGE AND HERITAGE: Language families in India – Dravidan Languages – Tamil as a Classical language – Classical Literature in Tamil – Contribution of U. Ve. Saminathaiyar. ArumukaNavalar – Importance of Tamil language in technical education.

அலகு 2	**திணைகருத்துக்கள்**	**9**

திணைகருத்துக்கள் : ஐந்து வகை நிலங்கள், தமிழர்களின் தாவரங்கள் மற்றும் விலங்கினங்கள், கடவுள்கள், தொழில்கள், வாழ்க்கை முறை, பண், கூத்து, உணவுமுறை – தொல்காப்பியம் மற்றும் சங்க இலக்கியங்களில் இருந்து அகம் மற்றும் புறம் கருத்து தமிழ் அறம் கருத்து சங்ககாலத்தில் கல்வி மற்றும் எழுத்தறிவு பண்டைய நகரங்கள் மற்றும் சங்க காலத்தில் துறைமுகங்கள் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - சோழ மன்னர்களின் வெளிநாட்டு வெற்றிகள்.

UNIT 2   THINAI CONCEPTS   9

Thinai concepts : -Five types of lands, animals, Gods, occupation, life styles, music, dance , food style, Floara and Fauna of Tamils - Agam and puram concept from Tholkappiyam and Sangam Literature - Aram concept of Tamil - Education and Literacy during Sangam Age - Ancient cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Choloas.

அலகு 3   தமிழரின் மரபு   3

இந்திய தேசிய சுதந்திர இயக்கம் மற்றும் இந்திய கலாச்சாரத்திற்கு தமிழர்களின் பங்களிப்பு:- சுப்ரமணியபாரதி, வாஞ்சிநாதன், சுப்பிரமணிய சிவா, வீரபாண்டிய கட்டபொம்மன், வா. ஊ. சிதம்பரம் பிள்ளை, தீரன் சின்ன மலை, மருது பாண்டிய சகோதரர்கள், பூலிதேவர், திருப்பூர் குமரன், வீரமங்கை வேலுநாச்சியார் - தமிழர் இலக்கியங்களில் மேலாண்மை கருத்துக்கள் (கி. மு. 500 முதல் கி. பி 200 வரை) - அகநானூறு, புறநானூறு, திருக்குறள் ஆகியவற்றில் மேலாண்மைக் கருத்துகள்.

UNIT 3   HERITAGE OF TAMILS   3

Contribution of Tamils to Indian National Freedom Movement and Indian Culture : Contrinutions of SubramanyaBharathi, Vanchinathan, Subramaniya Siva, VeerapandiyaKattabomman, V O Chidambaram Pillai, DheeranChinnamalai, The MaruthuPandiyar, Puli Thevar, TiruppurKumaran, VeeraMangaiVelunachiyar.

TOTAL: 15 PERIODS

பாடத்திட்டத்தின் வெளிப்பாடு:

After completion of this course, the students will be able to:

1. மாணவர்கள் தமிழ் மொழி தோற்றம் பற்றி தெரிந்து கொள்வார்கள்.

2. தமிழர்களின் வாழ்வியல் முறைகளை தெரிந்து கொள்வார்கள்.

3. தமிழர்களின் சுதந்திர போராட்ட வீரர்களை பற்றியும், மேலாண்மை முறைகளை பற்றியும் தெரிந்து கொள்வார்கள்.

பாடநூல்கள்:

1. பொன். முத்துகுமாரன் (2002), "தமிழ் மரபு", காந்தளகம், 68, அண்ணாசாலை, சென்னை 600 002.

2. பி. டி ஸ்ரீனிவாச ஐயங்கார் (தமிழக்கமும் திறனாய்வும்) புலவர் கா. கோவிந்தன் (1988), "தமிழர் வரலாறு (முதல்பகுதி)", திருநெல்வேலி தென்னிந்திய சைவசித்தாந்த

நூற்பதிப்புகழகம் , 154, TTK சாலை, சென்னை 18.

3. டாக்டர் கே. கே. பிள்ளை (2009), "தமிழக வரலாறு மக்களும் பண்பாடும், உலக தமிழாராய்ச்சி நிறுவனம், தரமணி, சென்னை 600113

4. முனைவர். ச. இராஜேந்திரன் (2004), "தமிழில் சொல்லாக்கம்", தஞ்சாவூர் தமிழ் பல்கலைக்கழகம் வெளியீடு
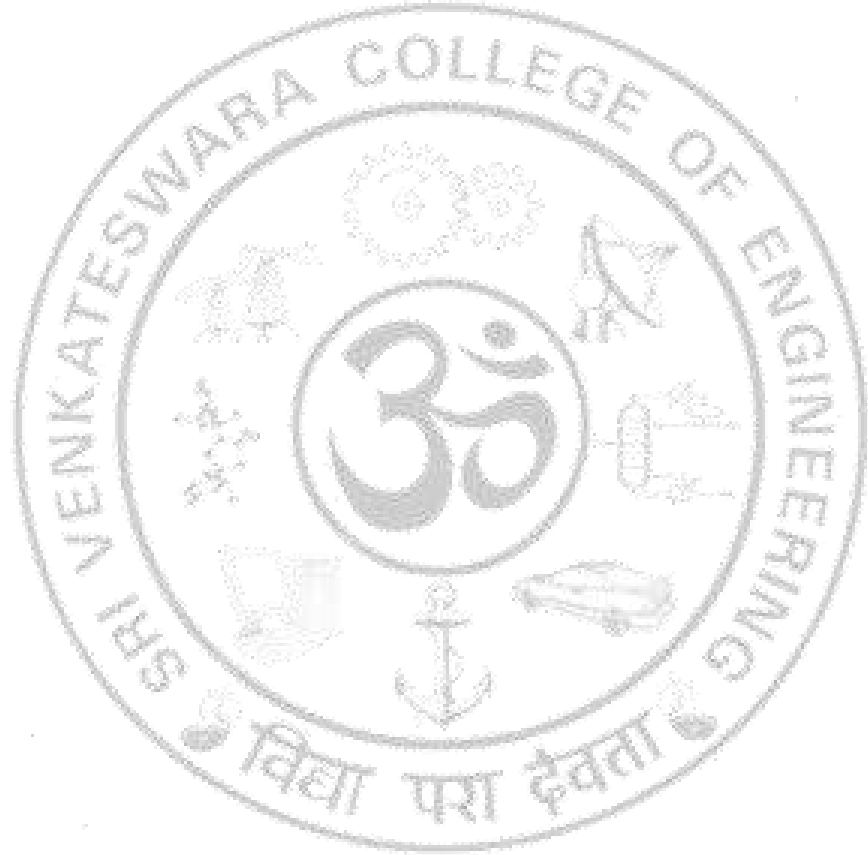
	L	T	P	C
	3	0	0	3

HS22152   **COMMUNICATIVE ENGLISH**

(Common to all Branches)

OBJECTIVES:

1. To enable learners to interact fluently on everyday social contexts.

2. To train learners to engage in conversations in an academic/scholarly setting.

3. To instill confidence in learner's to overcome public speaking barriers.

4. To develop learner's ability to take notes and in the process, improve their listening skills.

5. To enhance learner's 'reading skill through reading text passages for comprehension and contemplation.

6. To improve learner's skills to write on topics of general interest and drafting correspondences for general purposes.

UNIT I   **9**

Listening - short video clips - conversational scenes form movies, celebrities' speeches /interviews. Speaking - several ways of introducing oneself at several situations, introducing others at several situations, inviting people for several occasions, describing people and their places. Reading - short comprehension passages - making inferences, critical analysis. Writing - completing the incomplete sentences - developing hints from the given information. Grammar - Wh-Questions and Yes or No questions - Parts of speech. Vocabulary development - prefixes - suffixes - articles - countable / uncountable nouns.

UNIT II   **9**

Listening - customer care voice files, short narratives - identifying problems and developing telephone etiquettes. Speaking - speaking over skype/ whatsapp, making business calls, making self-recorded informative videos, inquiring about a concept/activity, describing a concept/activity. Reading - reading the headlines on news magazines - slogans and taglines from advertisements. Writing - free writing - writing - headlines, slogans and taglines individual inspirations. Grammar-conjunctions, idioms, phrases, quotes. Vocabulary development - guessing the meanings of words in different contexts.

UNITIII   **9**

Listening - courtroom scenes from movies, debates and talks from news channels, notes taking. Speaking - language and tone for arguments, discussion, deliberation, contemplation, expressing opinions, reacting to different situations in an alien country. Reading - language used in instruction manuals of household appliances, cookery and other basic instructions. Writing- understanding the structure of texts - use of reference words, discourse markers- coherence, rearranging the jumbled sentences. Grammar - adjectives - degrees of comparison, framing direct and indirect questions. Vocabulary development - concise approach, single word substitution.

UNIT IV   9

Listening - Sports commentaries, advertisements with users' criticisms; Speaking - for social causes, for promoting a concept, negotiating and bargaining; Reading - review of a product, movie, movement or a system; Writing - writing for advertisements, selling a product; Grammar – Tenses - Simple Past, Present and Future, Continuous - Past, Present and Future; Vocabulary Development - synonyms, antonyms and phrasal verbs.

UNIT V   9

Listening - video lectures, video demonstration of a concept; Speaking – presenting papers/concepts, delivering short speeches, discourses on health, suggesting natural home remedies, cleanliness, civic sense and responsibilities; Reading - columns and articles on home science; Writing - correspondences of requests, basic enquiry/observation and basic complaints; Grammar - modal verbs, perfect tenses - Vocabulary development - collocations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Acquire adequate vocabulary for effective communication.	3
2.	Listen to formal and informal communication and read articles and infer meanings from specific contexts from magazines and newspapers.	3
3.	Participate effectively in informal/casual conversations; introduce themselves andtheir friends and express opinions in English.	4
4.	Comprehend conversations and short talks delivered in English.	6
5.	Write short write-ups and personal letters and emails in English.	6

TEXTBOOKS:

1. Department of English, Anna University, Mindscapes: English for Technologists and Engineers. Orient Black Swan, Chennai, 2017.

2. Downes and Colm, "Cambridge English for Job-hunting & quot; Cambridge University Press, New Delhi, 2008.

3. Murphy and Raymond, " Intermediate English Grammar with Answers ", Cambridge University.

4. Press, 2000. Thomson, A.J., " Practical English Grammar 1 & 2 ", Oxford, 1986.

SOFTWARES:

1. Face 2 Face Advance – Cambridge University Press, 2014.

2. English Advance Vocabulary- Cambridge University Press.

3. IELTS test preparation – Cambridge University Press 2017.

4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition.

5. Cambridge Preparation for the TOEFL TEST- Cambridge University Press, 2017.

WEB LINKS:

1. http://www.usingenglish.com

2. http://www.uefap.com3

3. https://owl.english.purdue.edu/owl/

4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
MA22151	**APPLIED MATHEMATICS I** **(Common to all Branches except MR)**	3	1	0	4

OBJECTIVES:

1. To compute eigen values and eigen vectors and use in diagonalization and in classifying real quadratic forms.

2. To study differential calculus and its applications to relevant Engineering problems.

3. To compute derivatives using the chain rule or total differentials.

4. To understand the rotation of two dimensional geometry using definite integrals.

5. To acquaint with the Mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I   **MATRICES**   **9+3**

Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors – Statement and Applications of Cayley-Hamilton Theorem –Diagonalization of matrices– Reduction of a quadratic form into canonical form by orthogonal transformation-Nature of quadratic forms

UNIT II   **APPLICATION OF DIFFERENTIAL CALCULUS**   **9+3**

Curvature and radius of Curvature– Centre curvature – Circle of curvature –Evolutes– Envelopes- Evolute as Envelope of Normals.

UNITIII   **DIFFERENTIAL CALCULUS FOR SEVERAL VARIABLES**   **12**

Limits and Continuity - Partial derivatives – Total derivatives – Differentiation of implicit functions – Jacobians and properties– Taylor's series for functions of two variables – Maxima and Minima of functions of two variables –Lagrange's method of undetermined multipliers.

UNIT IV   **APPLICATION OF DEFINTE INTEGRALS**   **12**

Integration by Parts-Bernoulli's formula for integration- Definite integrals and its Properties- Solids of Revolution- Disk Method- Washer Method- Rotation about both x and y axis and Shell method.

UNIT V   **MULTIPLE INTEGRALS**   **12**

Double integrals in Cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves - Change of variables in double integrals – Triple integrals – Volume of solids.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Solve the Eigen value problems in matrices.	3
2.	Apply the basic notion of calculus in Engineering problems and to tackle for different geometries.	3
3.	Perform calculus for more than one variable and its applications in Engineering problems.	3
4.	Apply definite integrals for design of three dimensional components.	3
5.	Evaluate multiple integral in Cartesian and polar coordinates.	3

TEXTBOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics", 10th Edition, John Wiley, (2015)

2. Grewal. B.S, Grewal. J.S "Higher Engineering Mathematics",43rd Edition, Khanna Publications, Delhi, (2015).

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Nineth Edition, Laxmi Publications Pvt. Ltd.,(2014).

2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education,(2016).

3. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2013).

WEB LINKS:

1. https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdf

2. https://www.sydney.edu.au/content/dam/students/documents/mathematics-learning- entre/integration-definite-integral.pdf

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
PH22153	**3**	**0**	**0**	**3**

TECHNICAL PHYSICS

(Common to BT, CH)

OBJECTIVES:

1. To enhance the fundamental knowledge in Physics and its applications relevant to various Streams of Engineering and Technology.

UNIT I   LASERS AND FIBER OPTICS   9

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG laser – CO2 Laser – Dye lasers, Exceimer Lasers – Applications. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers–Fiber optic communication- fibre optic sensors: pressure and displacement- Endoscope.

UNIT II   QUANTUM PHYSICS   9

Black body radiation – Planck's theory (derivation)- deduction of Wien's and Rayleigh Jean's law – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent wave equations – Finite potential wells - - particle in a one-dimensional - three dimensional potential box–Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNITIII   CRYSTAL PHYSICS   9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – interplanar distances- coordination number and packing factor for SC, BCC, FCC, HCP and diamond structure (qualitative) - crystal imperfections: point defects, line defects – Burger vectors, stacking faults.

UNIT IV   NEW ENGINEERING MATERIALS   9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – Classification of Biomaterials and its applications.

UNIT V   PHYSICS OF SOUND   9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination – factors affecting Acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - Acoustic grating –Non Destructive Testing – Pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Develop an understanding about photonics and Fiber Optic communication system.	2
2.	Acquire the knowledge of Quantum mechanics.	3
3.	Classify and demonstrate the fundamentals of crystals and their defects.	3
4.	Acquire the knowledge of New Engineering Materials.	2
5.	Enable to explore how sound is produced and propagates in material medium.	3

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L, "Engineering Physics", Dhanput Publications, 2015.

2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.

3. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.

4. Arumugam M, "Materials Science", Anuradha Publications, 2015.

5. Elementary Bio physics - An Introduction – P K Srivasthava, Narosa Pub.-2005

REFERENCE BOOKS:

1. David Halliday, Robert Resnick, Jearl Walker, "Principles of Physics", 10th Edition, Wiley, 2015.

2. Peter Atkins and Julio De Paula, "Physical Chemistry",10th Edition., Oxford University Press, 2014.

3. Arthur Beiser, Shobhit Mahajan and Rai Choudhury S, "Concepts of Modern Physics", 7th Edition, McGraw Hill Education, 2017.

4. Raghavan V, "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2010.

5. Pandey B.K., Chaturvedi.S. "Engineering Physics", Cengage Learning India Pvt.Ltd, 2012.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO2	3	2	2	2	3	-	-	-	-	1	-	2	-	-	-
CO3	3	2	-	-	-	-	-	-	-	1	-	-	-	-	-
CO4	3	2	2	2	3	2	2	-	-	1	-	2	-	-	-
CO5	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
CY22153	**TECHNICAL CHEMISTRY** **(Common to BT, CH, CE)**	3	0	0	3

OBJECTIVES:

1. To make the student conversant with the Electrodes, Corrosion and Protective coatings.

2. To make the student conversant with the photochemical process and laws of photochemistry.

3. To make the student conversant with the synthesis and applications of nanoparticles.

4. To make the student conversant with the characteristics and analysis of water.

5. To make the student conversant with the materials like polymers, composites and binding materials.

UNIT I   **ELECTROCHEMISTRY**   **9**

Electrodes and electrochemical cells – electrode potential, standard electrode potential, single electrode potential and its determination, types of electrodes – calomel, quinhydrone and glass electrode. Nernst equation – determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Batteries – Primary (dry cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery) and next generation batteries.

UNIT II   **PHOTOCHEMISTRY**   **9**

Laws of photochemistry – Grotthuss-Draper law, Stark–Einstein law and Lambert Beer Law – determination iron by spectrophotometer. Quantum efficiency – Photo physical processes - internal conversion, inter-system crossing, fluorescence, phosphorescence and photo-sensitization-Quenching of fluorescence and its kinetics, Stern-Volmer relationship. Applications of photochemistry.

UNIT III   **NANOCHEMISTRY**   **9**

Basics and scale of nanotechnology, different classes of nanomaterials, Distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Synthesis of nanomaterials, fabrication (lithography) and its applications – Basics of nanophotonics and quantum confined materials (surface plasmon resonance).

UNIT IV   **WATER TECHNOLOGY**   **9**

Sources, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Water characteristics – Hardness – Types of hardness – Disadvantages of hard water. Boiler troubles: Scale, Sludge, Priming and Foaming, Caustic embrittlement and Boiler corrosion. Water softening methods - Internal treatment of water: Carbonate conditioning, Phosphate conditioning and Calgon conditioning - External treatment of water: Ion exchange process. Domestic water treatment. Water analysis: Hardness – determination by EDTA method, Alkalinity – determination by double indicator method, Determination of dissolved oxygen by Winkler's method and Determination of chloride by Mohr's method.

UNIT V   MATERIALS CHEMISTRY   9

Polymers: Introduction – Monomers, functionality and its significance, Free radical polymerization mechanism. Conducting polymers – mechanism of conduction in polyacetylene and applications.

Composites: Definition, need for composites. Constitution – Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of composites materials. Hybrid composites, Binding materials and its applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Identify electrochemical cells, corrosion and fundamental aspects of batteries.	2
2.	Interpret the photochemical reactions and make use of spectroscopic techniques.	3
3.	Realize the structures, properties and applications of nanoparticles.	3
4.	Describe the hardness of water, the problems caused by the hard water and their removals methods.	2
5.	Illustrate the significance of various materials like polymer, composites their composition, properties and applications.	3

TEXTBOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpet Rai & Sons, New Delhi, 17th Edition, 2018.

2. S.S.Dara, "A Text Book of Engineering Chemistry", S.Chand& Co. Ltd., New Delhi, 12th Edition, 2016.

REFERENCE BOOKS:

1. B.R. Puri, L.R. Sharma, M.S. Pathania., "Principles of Physical Chemistry" Vishal Publishing Company, 2008.

2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	3	3	-	-	-	-	3	-	-	-
CO3	3	3	3	-	-	3	3	3	-	-	-	3	-	-	-
CO4	3	3	-	2	-	3	3	3	-	-	-	3	-	-	-
CO5	3	3	3	-	-	3	3	3	-	-	-	3	-	-	-

1-Weak; 2-Moderate; 3-Strong.
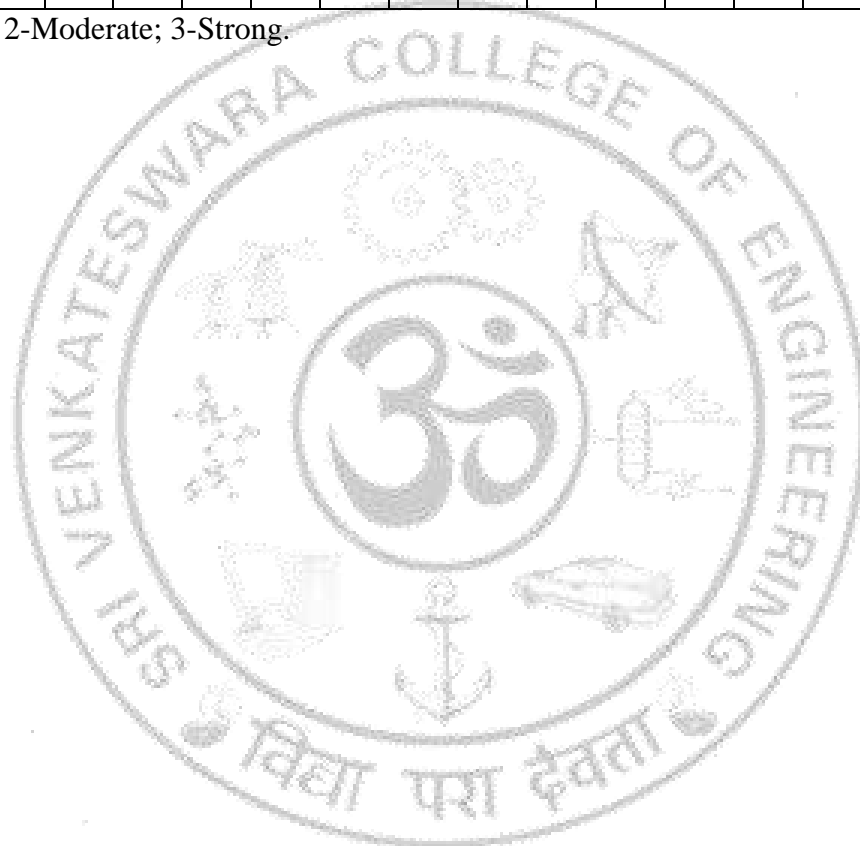
ME22151	**ENGINEERING GRAPHICS** (Common to BT, CH)	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

1. To introduce the students to build their ability to read drawings and interpret the position and form of simple geometries.

UNIT 0	**CONCEPTS AND CONVENTIONS AND GEOMETRIC CONSTRUCTION (NOT FOR EXAM)**	**2**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning.

UNIT I	**CONICS, CYCLOIDAL CURVES AND INVOLUTES**	**10**

Geometric construction - Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Drawing of tangents and normal to the above curves - Construction of cycloid, epicycloid and hypocycloid - Drawing of tangents and normal to the above curves. Construction of involutes of square, pentagon and circle - Drawing of tangents and normal to the above involutes.

UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACES**	**12**

Orthographic projection – principles - Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (polygonal and circular surfaces) inclined to one of the principal planes and perpendicular to other by rotating object method.

UNITIII	**PROJECTION OF SOLIDS**	**12**

Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Projections of hollow prism and hollow cylinder with centrally drilled hole or square through its ends by rotating line method - axis is inclined to one of the principal planes and parallel to the other.

UNIT IV	**BLOCK FLOW DIAGRAM USING CAD**	**12**

Introduction to Computer Aided Drafting hardware - Overview of application software -2D drafting commands (AutoCAD) for simple shapes - Block flow diagrams - Dimensioning.

UNIT V	**ORTHOGRAPHIC AND ISOMETRIC VIEWS USING CAD**	**12**

Introduction to tolerance - Annotation in CAD - Isometric views - Orthographic views - 3D Modelling basics - 3D to 2D conversion.

TOTAL: 60 (30L+30P) PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Construct conic sections and as per drawing standards.	2
2.	Obtain orthographic projections of lines and plane surfaces and simple solids in various positions.	3
3.	Obtain projections of simple and hollow solids.	3
4.	Employ the CAD software for drafting and modelling of simple components.	2
5.	Construct 2D views from 3D models using CAD software.	3

TEXTBOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.

2. Dhananjay M. Kulkarni, A.P. Rastogi, Ashoke K. Sarkar, "Engineering Graphics with AutoCAD", PHI Learning Private Ltd., 2009.

3. Venugopal K. and Prabhu Raja V., "Engineering Drawing +AutoCAD", New Age International (P) Limited, 6th edition, 2022.

REFERENCE BOOKS:

1. Dhananjay A Jolhe, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw-Hill Publishing Company Limited, 2008.

2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.

3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

4. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

WEB LINKS:

1. Block flow diagram - https://media.ed.ac.uk/media/1_u4r3az7t

2. AutoCAD tutorials - https://www.thesourcecad.com/autocad-tutorials

3. https://nptel.ac.in/courses/112105294

4. https://nptel.ac.in/courses/112103019

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	1	3	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	1	3	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.
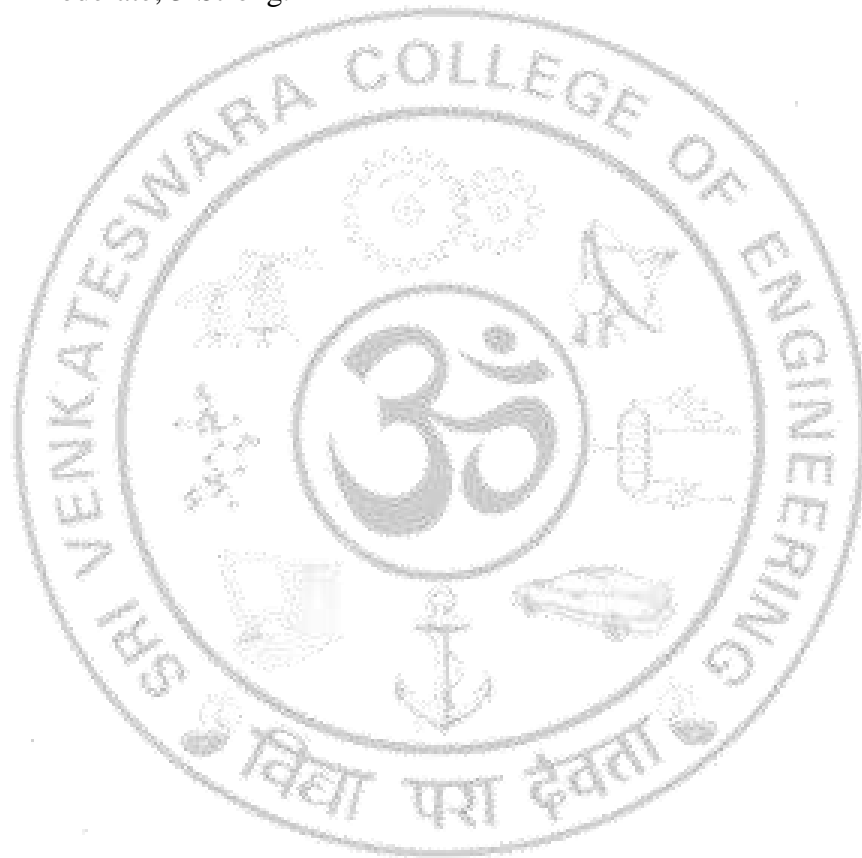
		L	T	P	C
ME22152	**BASICS OF MECHANICAL ENGINEERING** (Common to BT, CH)	3	0	0	3

OBJECTIVES:

1. To teach the fundamentals of various energy resources.

2. To impart the concepts in internal combustion Engines.

3. To make the students to understand the working principle of refrigeration and Air conditioning systems.

4. To impart the various engineering materials and their processing methods.

5. To give an awareness about the recent trends in Mechanical engineering.

UNIT I   ENERGY RESOURCES   10

Classification of Energy Resources - Non-renewable and renewable energy resources. Nonrenewable energy resources – Steam power plant, Nuclear power plant, Hydroelectric power plant, Gas Turbine power plant. Diesel Power plant.

Renewable Energy resources – Solar Energy, Wind Energy, Bio energy, tidal energy, fuel cells

UNIT II   INTERNAL COMBUSTION ENGINES   9

Classification, I.C. Engines parts and their function, working of 2 Stroke and 4 stroke engines. Basic terms - Indicated power, brake power frictional power, thermal efficiency, mechanical efficiency (simple problems).

UNITIII   REFRIGERATION AND AIR CONDITIONING   9

Refrigeration: Types of refrigerants and properties of good refrigerant, Refrigerating effect and unit of Refrigeration (definition). Working principle of vapor Compression refrigeration and vapor absorption refrigeration (with a sketch). Applications areas of a refrigeration system. Basic Calculations.

Air Conditioning: Definition, Types, Room air-conditioning working principle (with a sketch), Applications. Calculation of Tonnage requirement based on the room size.

UNIT IV   MATERIALS AND MANUFACTURING PROCESSES   10

Engineering Materials: Classification – Properties – Alloys and their applications; Manufacturing Processes – classification – Casting – Pattern, Core, Green sand Mouldpreparation, Investment casting; Metal Joining Process – Arc welding and Gas welding process, Soldering and Brazing – introduction ; Metal forming Process – Forging, rolling, Extrusion – introduction; Metal Removal process – Lathe, Milling, Drilling

UNIT V   RECENT TRENDS IN MECHANICAL ENGINEERING   7

Hybrid and Electric vehicle – layout and Principle; Additive Manufacturing – Introduction and types; Robotics – Introduction – Types of robot and applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Understand the various energy resources and the principle of their operations.	2
2.	Identify the types of IC engines and will calculate the various parameters.	3
3.	Understand the principle of refrigeration and Air-conditioning.	2
4.	Learn the various Engineering Materials and the manufacturing processes.	2
5.	Know the recent trends in I.C. engines and manufacturing.	1

TEXTBOOKS:

1. Dr Sadhu Singh, Elements of Mechanical Engineering, S. Chand Publishing, 2010.

2. Basant Agrawal, C.M. Agrawal. Basic Mechanical Engineering, Wiley India Pvt Ltd, 2008.

3. Pravin Kumar, Basic Mechanical Engineering, 2nd Edition Pearson India, 2018.

4. R.K. Rajput, Basic Mechanical Engineering, Lakshmi Publications, 2007.

5. Nag, P K, Basic Mechanical Engineering, McGraw-Hill Education (India) Pvt Limited, 2011.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
BT22101 **BIOLOGY FOR ENGINEERS** (Common to BT, AE, IT)	3	0	0	3

BT22101

BIOLOGY FOR ENGINEERS

(Common to BT, AE, IT)

OBJECTIVES:

1. To illustrate the unit of life and its function.

2. To study the implications of engineered products and process on living matters.

3. To understand biological function for the application in the product and process engineering.

4. To discuss the impact of the machine on human.

5. To understand the regulation and ethics.

UNIT I   **INTRODUCTION TO BIOLOGY**   **8**

Origin of life and Evolution, Cells - Prokaryotes and Eukaryotes, Biochemical nuts and bolts - water, carbohydrates, lipids, proteins, DNA, RNA and enzymes, Introduction to metabolism, Mendelian genetics, Chromatin, DNA structure, replication, transcription and translation. Human system - skeletal structure, types of connective tissues, structure of joints, muscle and organ structure and function, cardiac physiology, blood properties and flow, nervous system. Plant system-organization of plants, Photosynthesis and Respiration, Growth and Development Hormones. Microbial system - Bacteria, yeast, fungi, protozoan, Algae and virus.

UNIT II   **APPLICATION OF BIOLOGICAL PRINCIPLES IN ENGINEERING**   **12**

Biological functions for Camera for imaging, image recognition, visual information processing, Information and Communication Technologies, memristor, optoelectronic, speech recognition, smart sensing, sensorimotorics, neuromorphic and artificial intelligence. Biology in biomimicry – Sharkskin inspired swimsuits, Burr inspired Velcro, Whale fin inspired wind turbine blades, cooling fans, airplane wings and propellers, lotus inspired paintbrushes, Stenocara shell inspired water collection, skeleton structure of blowfish inspired designing of vehicles, termites and Scyliorhinuscanicular inspired architecture and natural colour inspired nanophotonic crystal.

UNITIII   **BIOLOGICALLY INSPIRED PRODUCTS, PROCESS, AND MATTERS**   **12**

Case study on workload ergonomics, system ergonomics and information ergonomics, Ultrasound imaging, X-Ray and PET scanning, Bioelectromagnetism - Touch Screen Technology, Force and torque sensor, inertial sensing technology and motion capture systems, Human-in-the-loop process, Bioactuators, Biocybernetics, Biotelemetry, Bionic (rehabilitation), Bioreactor, Bioremediation, Biofertilizer, Bioenergy, Biosensors, Biopolymers, Biofilters, Biochips, Microbial fuel cells in vehicles. Biotechnological reliance in space, agriculture and nuclear energy.

UNIT IV   **IMPACT OF MACHINE/DEVICES ON HUMAN**   **5**

Biological effects – Somatic and genetic effect, Exposure and health effects –

microwaves, radiation, radiofrequency and electronic gadgets, Man-made and Technological hazards, Impact on ecosystem - Chemical, nuclear, radiological, transportation and e-waste hazards.

UNIT V REGULATIONS 8

International and National regulatory bodies - Radiation in the electromagnetic spectrum, Electronic devices, Cell phones, Smart meters, Medical use of radiation and Nuclear power plants, Labeling Regulatory Requirements for Medical Devices, Ethics and privacy cameras and surveillance system, Regulation of Human Cloning and Embryonic Stem Cell Research, Privacy and ethical issues in 3D whole body scanning, Regulation of emerging gene technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Distinguish the structure and function of prokaryotic and eukaryotic cells.	4
2.	Explains the usage of biological principles in engineering.	2
3.	Integrate the concepts of biology with engineering through case studies.	3
4.	Describe the influence of biologically inspired materials/machine/devices on environment and society.	2
5.	Understand the regulations, ethics, security and safety of engineering applications.	2

TEXTBOOKS:

1. Johnson, A. T. Biology for engineers. CRC Press, 2011.
2. Vaccari, D. A., Strom, P. F., &Alleman, J. E. Environmental biology for engineers and scientists (Vol. 7, p. 242). New York: Wiley-Interscience, 2006.
3. Waite, G. N., & Waite, L. R. Applied cell and molecular biology for engineers. McGraw-Hill Education, 2007.
4. Khandpur, R. S. Biomedical instrumentation: Technology and applications (Vol. 1). New York: Mcgraw-hill, 2005.
5. Salvendy, G. (Ed.). Handbook of human factors and ergonomics. John Wiley & Sons, 2012.

REFERENCE BOOKS:

1. Nelson, D. L., Lehninger, A. L., & Cox, M. M. Lehninger principles of biochemistry. Macmillan, 2008.
2. Subrahmanyam, S. A Textbook of Human Physiology. S. Chand Limited, 1987.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., &Kuby, J. Kuby immunology.

Macmillan, 2007

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	2	1	-	-	2	-	-	-	2	-	1	-	-	-
CO4	-	1	-	2	-	-	3	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	3	3	-	-	-	1	-	-	-

1-Weak; 2-Moderate; 3-Strong.
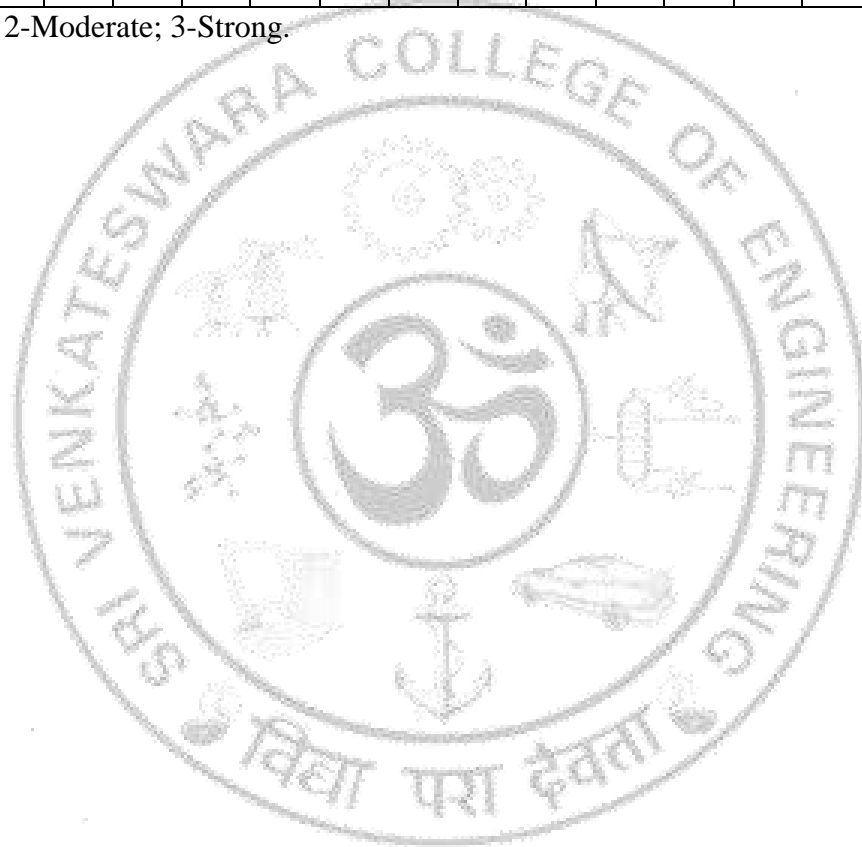
	CHEMISTRY LABORATORY	L	T	P	C
CY22161	(Common to all Branches except AD, CS, IT)	0	0	2	1

OBJECTIVES:

1. To acquaint the students with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and engineering field.

2. To appreciate the need and importance of water quality parameters for industrial and domestic use.

3. To gain the knowledge on electrochemical instrumentation techniques like potential and current measuring used in electrochemistry applications.

4. To impart knowledge on separation of componentsusing paper chromatography.

5. To enhance the thinking capabilityabout polymer and properties like molecular weight.

LIST OF EXPERIMENTS (Minimum 8 Experiments)

1. Determination of DO content of water sample by Winkler's method.

2. Determination of strength of given hydrochloric acid using pH meter.

3. Determination of strength of acids in a mixture using conductivity meter.

4. Estimation of iron content of the water sample using spectrophotometer (phenanthroline/thiocyanate method).

5. Determination of total, temporary & permanent hardness of water by EDTA Method.

6. Estimation of iron content of the given solution using potentiometer.

7. Determination of alkalinity in water sample.

8. Determination of Single electrode potential.

9. Separation of components from a mixture of red and blue inks using Paper chromatography.

10. Determination of molecular weight of polymer by using Ostwald's/Ubbelohde viscometer.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Distinguish hard and soft water, solve the related numerical problems on water, purification and its significance in industry and daily life.	3
2.	Interpret the knowledge of instruments to measure potential and current related parameters.	2

3.	Demonstrate the basic principle for separation of components using paper chromatography.	3
4.	Evaluate the molecular weight of polymer using Ostwald's/Ubbelohde viscometer.	3

TEXTBOOKS:

1. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel"s Textbook of practical organic chemistry", LBS Singapore 1994.

2. Jeffery G.H., Bassett J., Mendham J.and Denny vogel"s R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.

REFERENCE BOOKS:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.

2. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	3	3	3	1	-	1	2	-	-	-
CO2	3	2	1	-	-	3	3	3	-	-	-	-	-	-	-
CO3	3	-	-	-	-	3	3	-	-	-	-	2	-	-	-
CO4	3	-	-	1	-	3	3	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
ME22162	**BASIC MECHANICAL ENGINEERING LABORATORY** (Common to AE, BT, CH)	0	0	2	1

OBJECTIVES:

1. To provide an exposure and hands on experience to the students on various basic mechanical engineering processes.

LIST OF EXPERIMENTS

1. Welding - Butt joint and lap joint using Electric Arc and Gas welding.

2. Machining – Turning and facing using Centre Lathe.

3. Sheet metal work – Making of a cylinder using GI sheet and finishing using rivets.

4. Drilling and Tapping – Drilling of holes precisely and making internal threads by Tapping for various sizes.

5. Casting – Mould preparation using simple solid pattern and casting.

6. Plumbing – Making household pipeline PVC pipes, valves, taps, couplings, unions, reducers, elbows.

7. Fuel testing – Determination of Flash point and Fire point of fuels.

8. Refrigeration and Air Conditioning – Determination of Coefficient of Performance (COP) of refrigeration and air conditioning systems.

9. Automation – Basic pneumatic circuit using single and double acting cylinder.

10. 3D printing –Demonstration of printing of simple solids using Additive Manufacturing/3D printing.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	To fabricate components by various manufacturing processes.	3
2.	To prepare pipeline for a given application.	3
3.	To evaluate the ignition properties of fuels.	3
4.	To determine the efficiency of refrigeration and air conditioning Systems.	3
5.	To understand the principles of low-cost automation using pneumatic circuits.	2
6.	To understand the principle of additive manufacturing/3D printing.	2

REFERENCE BOOKS:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.

2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Publishing House Pvt.Ltd, 2006.

3. Bawa H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.

4. Rajput. R.K., "Thermal Engineering", Laxmi Publications, Tenth Edition, 2017.

5. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

6. Anthony Esposito, Fluid Power with Applications, Pearson Education, 7th edition, 2009.

7. Mechanical engineering practices lab manual, SVCE, 2022.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO6	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
அறிவியல் மற்றும் தொழில் நுட்பத்தில் தமிழ் **HS22251** **SCIENCE AND TECHNOLOGY IN ANCIENT TAMIL SOCIETY** **(Common to all branches)**	2	0	0	2

பாடத்தின் நோக்கங்கள்:

1. அறிவியலில் தமிழின் பயன்பாடு பற்றி தெரிந்து கொள்வார்கள்.

2. தொழில்நுட்பத்தில் தமிழ் பாரம்பரியத்தின் தாக்கம் பற்றி அறிந்து கொள்வார்கள்.

OBJECTIVES:

1. To know about the use of Tamil in science.

2. To learn about the impact of Tamil heritage on technology.

அலகு 1	அறிவியல் தமிழ்	5

கருவி உருவாக்கம் – ஆராய்ச்சி மேம்பாடு – கல்வி வளர்ச்சி – அறிவியல் தமிழ் சொற்கள் உருவாக்கம்.

UNIT I **SCIENTIFIC TAMIL**

Scientific Tamil : Tool Development - Research Development - Educational Development - Scientific Tamil words Creation.

அலகு 2	தொழில் நுட்பத்தில் தமிழ்	25

வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் : சங்ககாலத்தில் கட்டுமானப் பொருட்கள் – சோழர்களின் பெரியகோவில்கள் மற்றும் பிற வழிபாட்டு தலங்கள் – பல்லவர்களின் சிற்பங்கள் மற்றும் கோவில்கள் (மாமல்லபுரம்) -நாயக்கன் கால கோவில்கள் (மதுரை மீனாட்சி அம்மன் கோவில்), திருமலை நாயக்கர் மஹால், செட்டிநாட்டு வீடுகள். உற்பத்தி தொழில் நுட்பம் : கப்பல் கட்டும் கலை, உலோகவியல் ஆய்வுகள், தங்கம், தாமிரம், இரும்பு பற்றிய அறிவு – தொல் பொருள் சான்றுகள் – சுட்டக் களிமண் மணிகள், சங்குமணிகள், எலும்பு மணிகள்.

விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பம் : அணைகள், ஏரிகள், குளங்கள், மதகுகள், சோழர் காலகு முழிதூம்பு ஆகியவற்றின் முக்கியத்துவம் – கால்நடை பராமரிப்பு, கால்நடைகளின் பயன்பாட்டிற்காக வடிவமைக்கப்பட்ட கிணறுகள். விவசாயம் மற்றும் வேளாண் செயலாக்கம் – கடல் பற்றிய அறிவு – மீன்

பிடித்தல், முத்து குளித்தல், சங்கு சேகரித்தல்.

தமிழ் கணினி: அறிவியல் தமிழ் வளர்ச்சி – தமிழ் கணினி, தமிழ் புத்தகங்களின் டிஜிட்டல் மயமாக்கல், தமிழ் டிஜிட்டல் நூலகம், தமிழ் மென்பொருள் உருவாக்கம் – தமிழ் மெய்நிகர் அகாடமி – சொற்குவை திட்டம்.

தமிழின் எதிர்காலமும் தகவல் தொழில்நுட்பமும்- உலகமயமாக்கலும் தகவல் தொழில்நுட்பமும் – கணினிக்கு தமிழ் கற்று கொடுத்தல் – தமிழ் மொழித் தொழில்நுட்பத்தில் வளங்கள்.

UNIT II   TAMIL IN TECHNOLOGY

Design and Construction Technology: Building materials in Sangam age – Great temples of Cholas and other workship places – Sculptures and Temples of Pallavas (Mamallapuram) – Temples of Nayakas period (Madurai Meenakshiamman temple), ThirumalaiNayakar Mahal, Chetti Nadu Houses.

Manufacturing Technology: Art of Ship building, Metallurgical studies, Knowledge about Gold, Copper, Iron – Archeological evidences – Terracotta beads, Shell beads, Bone beads.

Agriculture and Irrigation Technology: Dams, Tank, ponds, sluice, Significance of Kumuzhi Thoompu of Cholas period- Animal Husbandry, Wells designed for cattle use. Agriculture and Agro processing, - Knowledge about Sea – Fisheries, Pearl, Conche diving.

Tamil Computing: Development of Scientific Tamil – Tamil Computing, Digitization of Tamil books, Tamil Digital Library, Development of Tamil Softwares – Tamil virtual Academy – Sorkuvai project.

Future of Tamil and Information Technology- Globalization and Information Technology-Teaching Tamil for Computer-Resources in Tamil Language Technology.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	அறிவியலில்தமிழ்மொழியின்பயன்பாடுபற்றிதெரிந்துகொள்வார்கள்.	2
2.	பல்வேறு தொழில்நுட்பத்தில் தமிழ் மொழியின் தாக்கம் பற்றி அறிந்து கொள்வார்கள்.	3

பாட நூல்கள்:

1. டாக்டர், வா.செ .குழந்தைசாமி (1985), " அறிவியல் தமிழ் " , பாரதி பதிப்பகம், 126/108, உஸ்மான் சாலை, தியாகராய

நகர், சென்னை 600017.

2. சுப. திண்ணப்பன், (1995), "கணினியும் தமிழ் கற்பித்தலும், புலமை வெளியீடு, 38-B மண்ணத்ந தோட்டத்தெரு, ஆழ்வார்பேட், சென்னை 600018.

3. மு. பொன்னவைக்கோ, (2003), "வளர்தமிழில்அறிவியல் – இணையத்தமிழ்", அனைத்திந்திய அறிவியல் தமிழ்க் கழகம், தஞ்சாவூர் 615 005.

4. துரை. மணிகண்டன், (2008), "இணையமும் தமிழும்", நல் நிலம் பதிப்பகம், 7-3, சிமேட்லி சாலை, தியாகராய நகர், சென்னை 600 017.
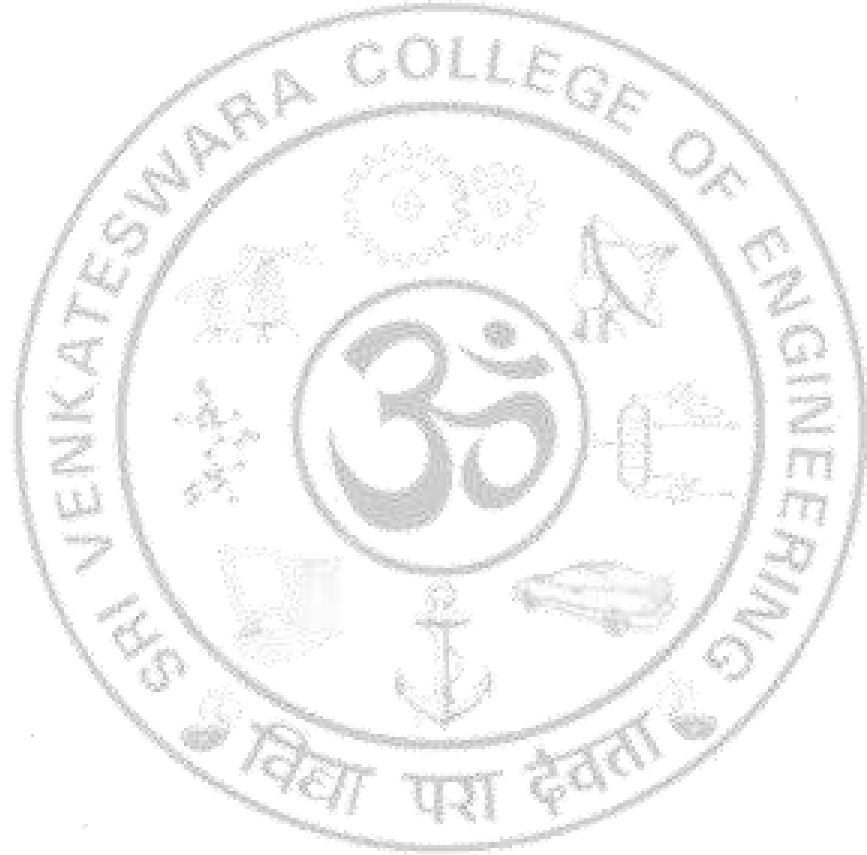
	L	T	P	C
HS22252				

TECHNICAL ENGLISH

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To enable learners to define and understand technical communication and scientific writing.

2. To expose learners to the technicalities of seminar presentation, group discussion, and public speaking.

3. To develop learners' writing skills for scientific and documenting purposes.

4. To improve learners' ability to draft correspondences for business purposes.

5. To cultivate learners' ability to holistically understand the nuances of job interviews and recruiting process.

UNIT I 9

Listening - AV files pertaining to manufacturing processes of products, scientific documentaries; Speaking - syllable division and word stress, intonation, sharing opinions; Reading - news articles related to science and technology; Writing - definitions, instruction, recommendation, data interpretation, resume; Grammar - tenses and their aspects, sentence connectors – discourse markers, sequential words, active and passive voice, subject-verb agreement.

UNIT II 9

Listening - AV pertaining to marketing strategies, peer reading and pronunciation; Speaking- turn taking, sharing opinions; conducting and attending a meeting, understanding the nuances of spoken communication among internal audience and external audience; Reading - analytical documents, descriptive documents; Writing - fliers, brochures, resume - letter of application, checklists; Grammar - modal verbs, clauses - types and uses, conditional clauses, articles.

UNITIII 9

Listening - AV related to how to use components, scientific description, Speaking - speaking for motivation and initiation, speaking at a seminar presentation; Reading - scientific journals, papers; Writing - Technical descriptions - process description, purpose and function, PowerPoint, Google forms, user manuals; Grammar - phrasal verbs, prepositions, technical and scientific affixes.

UNIT IV 9

Listening - scientific debates, crisis management; Speaking - handling conflicts, speaking about the loss of benefits, progress or decline of business, identifying the connotative meanings, Reading- documented evidences of uses and functions of a product, review of a product, Writing - memos, follow-up letters, reports - proposal, project, progress reports, sales reports, reports on industrial visits, executive summary. Grammar - reported speech and tag questions, sentence structure - comparative, imperative, cause and effect, infinitive of result.

UNIT V

Listening - AV of Group discussions, panel discussions, face to face interviews for recruitment purposes; Speaking- speaking at group discussions, interviewing a personality, answering at the interviews; Reading - WebPages of top notch engineering companies, Writing - blogging, e-mails, letter of complaint, minutes of the meeting; Grammar - one word substitution, collocations, better word/sentence substitution (rephrasing the content/improvising ideas).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Understand the nuances of technical communication and scientific writing.	3
2.	Present papers and give seminars.	6
3.	Discuss in groups and brainstorm.	6
4.	Draft business correspondences and write for documenting purposes.	6
5.	Face job interviews with confidence.	6

REFERENCE BOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012.

2. Downes, Colm, Cambridge English for Job-hunting, Cambridge University Press, New Delhi. 2008.

3. Murphy, Raymond, Intermediate English Grammar with Answers, Cambridge University Press 2000.

4. Thomson, A.J., Practical English Grammar 1 & 2, Oxford, 1986.

5. Herbert A J, The Structure of Technical English, Longman, 1965.

WEB LINKS:

1. http://www.usingenglish.com

2. http://www.uefap.com3

3. https://owl.english.purdue.edu/owl/

4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

SOFTWARES:

1. Face 2 Face Advance – Cambridge University Press, 2014.

2. English Advance Vocabulary- Cambridge University Press.

3. IELTS test preparation – Cambridge University Press 2017.

4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition.

5. Cambridge Preparation for the TOEFL TEST- Cambridge University Press, 2017.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
MA22251	**APPLIED MATHEMATICS II** **(Common to all Branches except MR)**	3	1	0	4

OBJECTIVES:

1. To acquire the concepts of vector calculus needed for problems in all engineering disciplines and compute different types of integrals using Green's, Stokes' and Divergence theorems.

2. To skilled at the techniques of solving ordinary differential equations that model engineering problems.

3. To extend the student's ability of using Laplace transforms to create a new domain in which it is easier to handle the problem that is being investigated.

4. To explain geometry of a complex plane and state properties of analytic functions.

5. To understand the standard techniques of complex variable theory so as to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

UNIT I   VECTOR CALCULUS   12

Gradient, divergence and curl - Directional derivative - Vector identities – Irrotational and solenoidal vector fields - Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem in a plane, Gauss divergence theorem and Stokes'theorem (excluding proofs) – Verification and application in evaluating line, surface and volume integrals.

UNIT II   ORDINARYDIFFERENTIAL EQUATIONS AND ITS APPLICATIONS   12

Differential equations of first order – Equations of the first order and first degree – Linear equations – Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients – Applications of Linear differential equations – Oscillatory electrical circuit – Deflection of beams.

UNITIII   LAPLACE TRANSFORM   12

Conditions for existence - Transform of elementary functions - Transforms of unit step function and impulse functions – Basic properties – Shifting theorems - Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Initial and final value theorems - Transform of periodic functions. Inverse Laplace transforms - Convolution theorem – Application to solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV   ANALYTIC FUNCTIONS   12

Analytic functions - Necessary and sufficient conditions (Cauchy-Riemann equations) - Properties of analytic function - Harmonic conjugates - Construction of analytic

functions - Conformal mapping – Mapping by functions $W = Z + C$, CZ, $1/Z$, Z^2 – Joukowski's transformation- Bilinear transformation.

UNIT V   COMPLEX INTEGRATION   12

Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series expansions - Singular points - Residues - Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Interpret the fundamentals of vector calculus and execute evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems.	3
2.	Solve first order linear, homogeneous differential equations and use series solution method to solve second order differential equations.	3
3.	Determine the methods to solve differential equations using Laplace transforms and Inverse Laplace transforms.	3
4.	Explain Analytic functions and Categorize transformations.	3
5.	Perform Complex integration to evaluate real definite integrals using Cauchy integral theorem and Cauchy's residue theorem.	3

TEXTBOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics", 10th Edition, John Wiley, (2015).

2. Grewal .B.S, Grewal .J.S "Higher Engineering Mathematics",43rd Edition, Khanna Publications, Delhi, (2015).

REFERENCE BOOKS:

1. Dass, H.K., and RajnishVerma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.

2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2013).

3. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", 9th edition, Laxmi Publications (p) Ltd., 2014.

WEB LINKS:

1. https://nptel.ac.in/courses/111/105/111105134/

2. https://nptel.ac.in/courses/111/105/111105121/

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-

1-Weak; 2-Moderate; 3-Strong.

PH22251	PHYSICS FOR BIOTECHNOLOGISTS	L	T	P	C
		2	0	2	3

OBJECTIVES:

1. To introduce the students to the principles of Medical Ultrasonic, electron microscopy, and various spectroscopic techniques.

2. To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

UNIT I   MEDICAL PHYSICS   10

Introduction- Ultrasonic-Production of ultrasonic waves-Ultrasound picture of human body-Block diagram of basic pulse Echo system- A Scan, B-Scan- and M-Scan-Psychological effect of Ultrasound therapy- Phonocardiography (PCG)- Source of radioactivity for nuclear medicine- Statistical aspects- Basic instrumentation(Geiger-Muller counter, Photo multiplier tube) and its clinical application (thyroid and Kidney function) – Nuclear Medicine imaging device- Gamma Camera- Positron camera.

UNIT II   BIO ENGINEERING MATERIALS   10

Introduction to Ceramics and its application- Ceramic Fibers – Fiber reinforced Plastics- Fibre reinforced Metal- Ferroelectric Materials-Electro and magneto rheological fluids- Sensor- Bio Sensors and Actuators-Scintillation detector (Position Sensitive).

UNIT III   CHARACTERIZATION TECHNIQUE   10

Electron Microscopy: Interaction of electrons with solids, Scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, Wavelength dispersive spectroscopy and AFM with their merits, limitations and applications.

Spectroscopic Techniques for chemical analysis: Atomic absorption spectroscopy, UV / Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy and Biomolecular NMR Spectroscopy (Qualitative)

LIST OF EXPERIMENTS

1a.   Determination of Wavelength, and particle size using Laser.

1b.   Determination of acceptance angle in an optical fiber.

2.   Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.

3.   Determination of thickness of a given Specimen – Air Wedge

4.   Energy band gap of a Semiconductor.

5.   Calibration of Voltmeter & Ammeter using potentiometer.

TOTAL: 60 (30L+30P) PERIODS

COURSE OUTCOMES:

After completion of this course, the students will be able to:

1. Enable to explore how High frequency sound is produced, propagated and Understand the detectors and methods used to monitor radiation dose and biological damage.

2. Apply a broad knowledge of different types of biomaterials including metals, polymers, ceramics and composites and their use in typical biomedical devices and clinical applications.

3. Explain the action of various types of microscopes, imaging and spectroscopic techniques.

4. Analyze the physical principle involved in various instruments, and also adapt the principle to new application.

5. Comprehend the Experiment from the Optics, mechanics and thermal physics to nurture the concepts in all branches of Engineering.

TEXTBOOKS:

1. Physics II byDr.M.Arumugam, Anuradha Publication Pvt. Ltd. 2005.

2. Engineering Physics II, P.K.Planisamy, Scitech Publication (India) Pvt.Ltd. 2013.

3. An Introduction to Materials Characterization by P. R. Khangaonkar, Penram International Publishing (India) Pvt. Ltd.2010.

REFERENCE BOOKS:

1. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications, 2007.

2. ASM Hand book-Materials characterization, Vol. 10, 2004.

3. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, 2008.
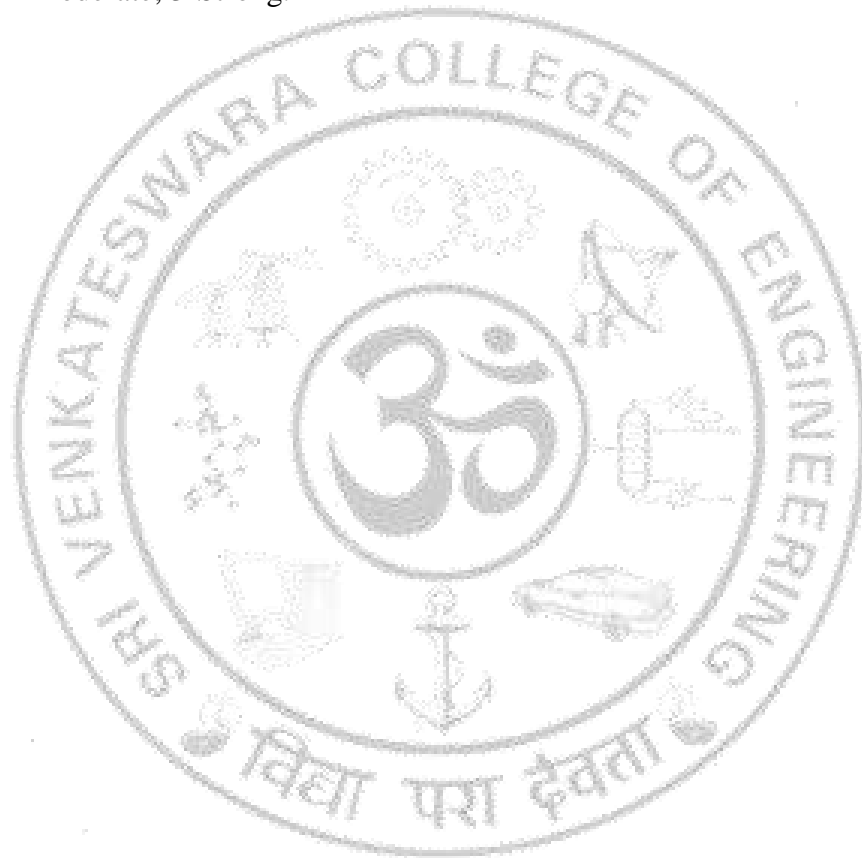
WEB LINKS:

1. https://conductscience.com/biomolecular-nmr-spectroscopy/

EVALUATION SCHEME:

Evaluation Elements	Weightage (%)
Theory (Units I,II,III)	60 %
Laboratory	40 %

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	2	2	-	-	-	1	-	2	-	-	-
CO2	3	-	-	-	2	-	-	-	-	1	-	2	-	-	-
CO3	3	2	2	2	2	2	-	-	-	1	-	2	-	-	-
CO4	3	3		3	2	2	-	-	3	1	-	2	-	-	-
CO5	3	3	2	3	2	2	-	-	3	1	-	2	-	-	-

1-Weak; 2-Moderate; 3-Strong.

	BASIC ELECTRICAL AND ELECTRONICS	L	T	P	C
EE22151	**ENGINEERING**				
	(Common to all Branches except CH, EE, EC)	3	0	0	3

OBJECTIVES:

1. To understand the basic theorems used in Electrical circuits.

2. To educate on the different concepts and functions of electrical machines.

3. To introduce electron devices and its applications.

4. To explain the principles of digital electronics.

5. To impart knowledge on the principles of measuring instruments.

UNIT I   **ELECTRICALCIRCUITS**   **9**

Ohm's Law – Kirchhoff's Laws - Steady State Solution of DC Circuits using Mesh and Nodal Analysis -Introduction to AC Circuits - Waveforms and RMS Value - Power and Power factor - Single Phase and Three Phase AC Balanced Circuits.

UNIT II   **ELECTRICAL MACHINES**   **9**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single phase induction Motor, Single Phase Transformer.

UNITIII   **SEMICONDUCTOR DEVICES AND APPLICATIONS**   **9**

Characteristics of PN Junction Diode - Zener Effect - Zener Diode - LED, Photo diode and its Characteristics-Half Wave and Full Wave Rectifiers-Voltage Regulation. Bipolar Junction Transistor-Common Emitter Configuration, Characteristics and CE as an Amplifier - Photo transistors.

UNIT IV   **DIGITAL ELECTRONICS**   **9**

Number System Conversion Methods–Simplification of Boolean Expression using K-Map – Half and Full Adders – Flip-Flops – Shift Registers - SISO, SIPO, PISO, PIPO and 4-bit Synchronous and Asynchronous UP Counters.

UNIT V   **MEASURING INSTRUMENTS**   **12**

Types of Signals: Analog and Digital Signals- Construction and working Principle of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters. Instrumentation Amplifier, – R-2R ladder Type D/A Converter - Flash Type and Successive Approximation Type A/D Converter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Compute the electric circuit parameters for simple problems.	4
2.	Understand the construction and characteristics of different	4

electrical machines.

3.	Describe the fundamental behavior of different semiconductor devices and circuits.	4
4.	Design basic digital circuits using Logic Gates and Flip-Flops.	4
5.	Analyze the operating principle and working of measuring instruments.	4

TEXTBOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.

2. SedhaR.S., "A Text Book of Applied Electronics", S.Chand&Co., 2014.

REFERENCE BOOKS:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics Engineering", Tata McGraw Hill, 2013.

2. MehtaVK,"Principles of Electronics", S. Chand &CompanyLtd, 2010.

3. M. Morris Mano, "Digital Logic & Computer Engineering", Prentice Hall of India, 2004.

4. Mahmood Nahvi and Joseph A.Edminister,"Electric Circuits", Schaum' Outline Series, McGraw Hill, Fourth Edition, 2007.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	2	-	-	-	-	2	-	-	-
CO2	3	3	3	3	-	-	2	-	-	-	-	2	-	-	-
CO3	3	3	3	3	-	-	2	-	-	-	-	2	-	-	-
CO4	3	3	3	3	-	-	2	-	-	-	-	2	-	-	-
CO5	3	3	3	3	-	-	2	-	-	-	-	2	-	-	-

1-Weak, 2-Moderate, 3-Strong.

		L	T	P	C
IT22251	**COMPUTER PROGRAMMING AND PRACTICE** **(Common to AE, BT, CH, CE)**	2	0	2	3

OBJECTIVES:

1. To know the basics of algorithmic problem solving.

2. To learn programming using a structured programming language.

3. To implement programs with basic features of C.

UNIT I **FUNDAMENTALS OF COMPUTING** **6+3**

Computing Devices – Identification of Computational Problems – Algorithms – Building Blocks of Algorithms - Pseudocodes and Flowcharts- Notion of memory, addresses, variables, instructions, execution of instructions- Operating system commands, file editing, compiling, linking, executing a program, Introduction to different programming languages.

Suggested Activities:

Practical - Use of operating system commands and file editing operations

UNIT II **BASICS OF C** **6+9**

Data types - constants, variables - operators - expressions - basic input/output. Statements and blocks - Selection - if-else construct - iteration - while - for constructs.

Suggested Activities:

Practical

Demonstration of programs using data types, operators and basic input/output.

Demonstration of programs using if else, else-if, switch.

Demonstration of programs using, while, for do-while, break, continue

UNITIII **ARRAYS AND STRINGS** **6+6**

Array, declaration, initialization. Multi dimensional arrays. Strings and character arrays, string operations on arrays

Suggested Activities:

Practical

Demonstration of programs using arrays and operations on arrays

Demonstration of programs implementing string operations on arrays

UNIT IV **FUNCTIONS AND STRUCTURES** **6+6**

Functions, definition, call, arguments, call by value. Call by reference. Recursion, Introduction to structures and unions.

Suggested Activities:
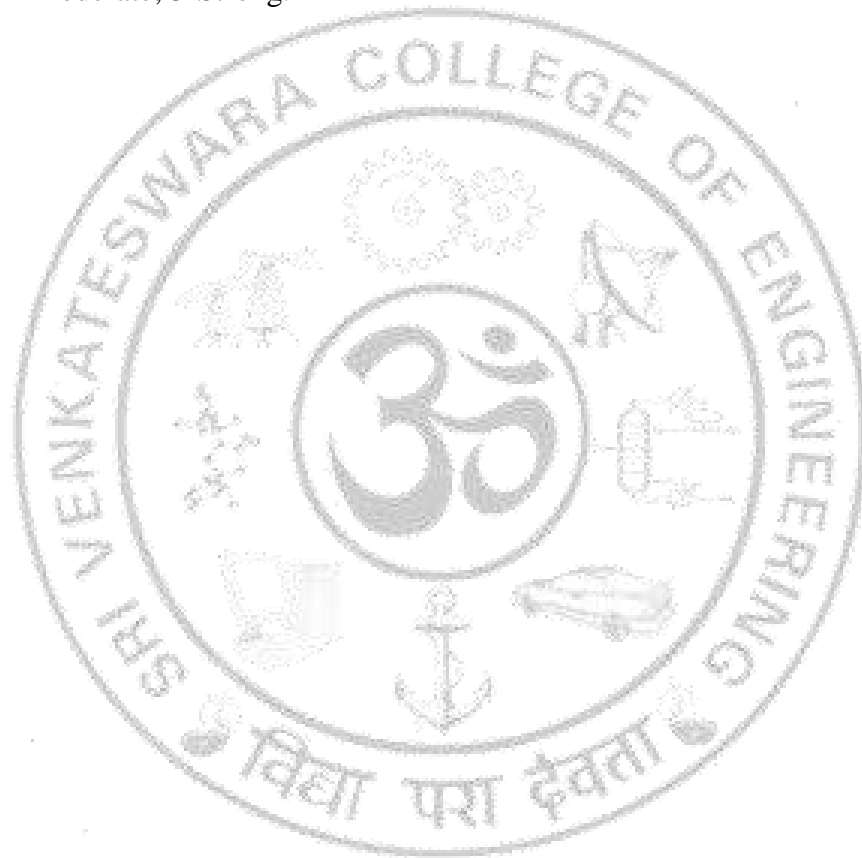
Practical

Demonstration of programs using functions.

Demonstration of programs using recursion

Demonstration of programs using Structures and Unions.

UNIT V   POINTERS AND FILE HANDLING IN C   6+6

Introduction to Pointers- pointers to basic variables, pointers and arrays. Pointers to strings Dynamic Memory Allocation, Files - binary, text - open, read, write, random access, close. Preprocessor directives

Suggested Activities

Practical

Demonstration of programs using pointers

Demonstration of programs using files

TOTAL: 60 (30L+30P) PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Apply appropriate programming constructs to solve problems.	3
2.	Design, implement, test and debug programs that use the basic features of C.	5
3.	Design modularized applications in C to solve real world problems.	6
4.	Use C pointers and dynamically allocated memory to solve complex problems.	4
5.	Apply file operations to develop solutions for real-world problems.	3

TEXTBOOKS:

1. PradipDey, Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018.

2. R G Dromey, "How to Solve it using Computer", Pearson,2006.

REFERENCE BOOKS:

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

2. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

3. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, Tata McGrawHill, 2010.

4. ReemaThareja, "Programming in C", 2nd ed., Oxford University Press, 2016.

EVALUATION SCHEME:

Evaluation Elements	Weightage (%)
Theory	60 %
Laboratory	40 %

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	-	-	-	-	-	-	3	-	-	2	-	-	-
CO2	1	-	3	2	1	-	-	-	3	-	-	2	-	-	-
CO3	1	-	3	2	1	-	-	-	3	-	-	2	-	-	-
CO4	1	-	3	2	1	-	-	-	3	-	-	2	-	-	-
CO5	1	-	3	2	1	-	-	-	3	-	-	2	-	-	-

1-Weak; 2-Moderate; 3-Strong.

L	T	P	C
3	0	0	3

BT22201   **BIOORGANIC CHEMISTRY**

OBJECTIVES:

1.   To recall the introduction of elements of atom, charges and their bonding rule.

2.   To understand the substitution and addition reactions in the mechanisms.

3.   To realize the key role of various kinetic mechanisms in Biotechnology.

4.   To know the role of catalysis in enzymatic reactions.

5.   To apply the application bioorganic reactions in transfer reactions and biosynthesis.

UNIT I   **BONDING AND STEREOCHEMISTRY**   **9**

Atoms Electrons and orbitals, Covalent Bonds, Octet rule, Polar covalant Bonds, Electronegativity formal charge, Resonance Acids and Bases, Arrhenius and Bronsted Lowry Theories, Acid Base equilbria, SP3 hybridization, Conformations analysis ethane, butane and cyclohexane, Cis-Trans isomerism, Denaturation and renaturation of DNA, Hyperchromic effect.

UNIT II   **MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS**   **9**

SN1 and SN2 reactions on tetrahedral carbon, nucleophiles, Mechanism steric effects, Nucleophilic addition on Acetals and ketals, Reactions of carbonyl group with amines, acid catalyzed ester hydrolysis, Saponification of an esterhydrolysis of amides, phospodiester bond formation in DNA. Conformational strain- DNA Supercoiling- non-functional proteins of translation.

UNITIII   **KINETICS AND MECHANISM**   **9**

Kinetic method, Rate law and mechanism, Transition states, Intermediates, Trapping of intermediates, Microscopic reversibility, Kinetic and thermodynamic reversibility, X–ray diffraction analysis of DNA, the Arrhenius equation Eyring equation , ΔG, ΔS, ΔH, Thermodynamics of coupled reactions.

UNIT IV   **CATALYSIS**   **9**

Reactivity, Coenzymes, Proton transfer, Metal ions, Intra molecular reactions, Covalent catalysis, role of catalysis by organized aggregates and phases in synthetic peptide based vaccines, Inclusion Complexation. Immunostimulatory complexes.

UNIT V   **BIOORGANIC REACTIONS**   **9**

Hogsteen base pairing, Bond formation and various bonds in DNA, Terpene biosynthesis Murrlfield state peptide synthesis, Sanger method for peptide and DNA sequencing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Know in detail about the elements of atom, charges and their bonding rule	2
2.	Understand the various kinetic properties and types of reaction mechanisms	2
3.	Understand the possible bio-organic reactions involved in biosynthesis	2
4.	Analyze various bioorganic based productions	3
5.	Apply the concepts of Bioorganic reactions	4

TEXTBOOKS:

1. Carey Francis A," Organic Chemistry", 7th Edition, Tata MCGraw Hill, 2009.

2. Page M.I and Andrew Williams, "Organic and Bio-organic Mechanisms", Pearson, 2010.

REFERENCE BOOKS:

1. Dugas Hermann, "Bioorganic Chemistry: A Chemical Approach to Enzyme Action", 3rd Edition, Springer, 2003.

2. Bansal, Raj K,. "A text book of organic chemistry" Wiley eastern chemistry (organic), 1986 Mehta, Bhupinder; Mehta, Manju "Organic Chemistry" Prentice-Hall of India, 2005

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	1	-	-	-	2	-	-	-	-	-	-	3	-	-	3
CO3	2	-	3	-	3	-	-	-	2	-	-	3	-	-	3
CO4	2	-	3	-	3	-	-	-	2	-	-	3	-	-	2
CO5	2	-	-	-	3	-	-	-	2	-	-	3	-	-	3

1-Weak; 2-Moderate; 3-Strong.

	BASIC ELECTRICAL AND ELECTRONICS	L	T	P	C
EE22111	ENGINEERING LABORATORY	0	0	2	1
	(Common to all Branches except EC)				

OBJECTIVES:

1. To provide exposure to the students with hands on experience in basic of Electrical and Electronics wiring connection and measurements.

2. To introduce the students to Electrical Machines and basic laws of Electrical Circuits.

LIST OF EXPERIMENTS

1. Wiring – Residential house wiring and Stair case wiring.

2a. AC Analysis- Measurement of electrical quantities–voltage, current, power, and power factor using RLC.

2b. Study of three phase system.

3. Energy conservation - Measurement and comparison of energy for incandescent lamp and LED lamp.

4a. Identification of circuit components (Resistor, Capacitor, Diode and BJT) and soldering practice.

4b. Signal Measurement- Measurement of peak to peak, RMS, average, period, frequency of signals using CRO.

5a. VI Characteristics of Solar photovoltaic panel.

5b. Design of Solar PV Array and Battery sizing for Residential solar PV system.

6. Design a 5V/12V Regulated Power Supply using FWR and IC7805 / IC7812.

7. DC Analysis- Verification of Ohm's Law and Kirchhoff's Laws.

8. Study of Transformer and motor characteristics.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

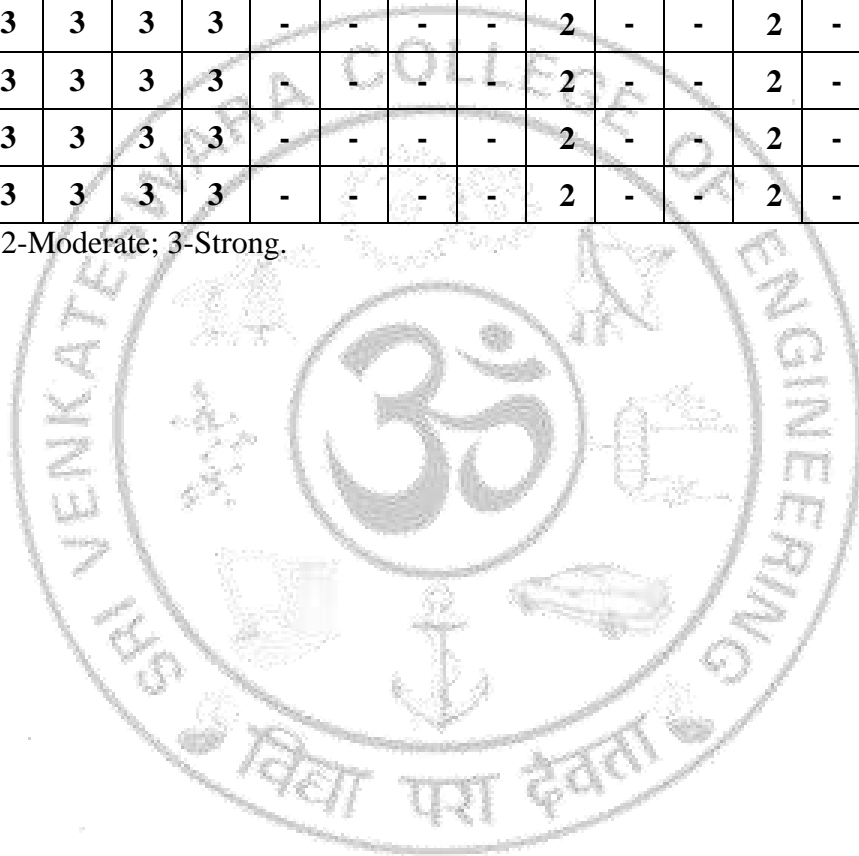| CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Wiring of basic electrical system and measurement of electrical parameters.	4
2.	Verifying the basic laws of Electric circuits and understand the working of Electrical Machines.	4
3.	Study of basic electronic components, circuits and solar photovoltaic panel and their implementation.	4
4.	Understand the concept of a three-phase system.	4
5.	Construct a fixed voltage regulated power supply and measure the	4

signals in each stage.

REFERENCE BOOKS:

1. Mittle V.N, Arvind Mittal, "Basic Electrical Engineering", Tata Mc Graw Hill (India), Second Edition, 2013.

2. Sedha R.S., "A Text Book of Applied Electronics", S.Chand&Co., 2014.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	2	-	-	2	-	-	-
CO2	3	3	3	3	-	-	-	-	2	-	-	2	-	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	2	-	-	-
CO4	3	3	3	3	-	-	-	-	2	-	-	2	-	-	-
CO5	3	3	3	3	-	-	-	-	2	-	-	2	-	-	-

1-Weak; 2-Moderate; 3-Strong.

BT22211   BIOORGANIC CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

1. To appraise the knowledge on organic molecules used in biotechnology

2. To learn and understand the principles behind the synthesis of bioorganic molecules

3. To learn and understand the principles behind the upstream and downstream processing in a chemical synthesis

4. To perform Laboratory analysis of the bioactive molecules

5. To understand the stereochemistry of biomolecules

LIST OF EXPERIMENTS

1. Synthesis of aspirin

2. Synthesis of acetaminophen

3. Preparation of oleic acid from olive oil

4. Preparation of alpha d- glucopyranose pentaacetate using perchloric acid

5. Hydrolysis of sucrose

6. Hydrolysis of an ester

7. Isolation of lycopene from tomato paste

8. Isolation of casein from milk

9. Isolation of curcumin from turmeric

10. Extraction of caffeine

11. Analysis of vitamin C

12. Analysis of phytochemicals

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Learn the methodology of synthesis of materials / that are used in pharma & biotech industries and be able to analyze their physical and chemical properties.	2
2.	Acquire the knowledge about the technique for isolation of phytochemicals from the natural sources. It will be helpful to them during their project work.	2
3.	Perform hands on experience on understanding the mechanism of biochemical reaction by in vitro studies.	3

4.	Acquire the practical knowledge on stereochemistry of biological molecules and its importance in research and industry.	2
5.	Learn the basic steps of upstream and downstream processing involved in the production of medicinally important compounds.	2

REFERENCE BOOKS:

1. Francis, A. Carey, "Organic Chemistry", 7th Edition, Tata MCGraw Hill, 2009.

2. Page, M. I. and Andrew Williams, "Organic and Bioorganic Mechanisms", 1st Edition, Pearson, 2010.

3. Fummis, B.S., Hannaford, A.J., Smith, P.W.G and Tatchell, A.R., "Vogel's Text Book of Practical Organic Chemistry", Pearson India, 2003.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	3	2	-	-	-	-	2	-	-	3	3	3
CO5	3	3	3	3	2	1	-	1	1	2	-	-	-	3	3

1-Weak; 2-Moderate; 3-Strong.

MA22355 — **PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS (Common to AE, BT and MN)**

L	T	P	C
3	1	0	4

OBJECTIVES:

1. To get skilled at the techniques of solving partial differential equations.

2. To understand the application of partial differential equations in heat transfer problems.

3. To learn the solution of algebraic, transcendental equations, system of linear equations.

4. To understand the concept of interpolation and approximation.

5. To understand how to solve initial and boundary value problems in differential equations.

UNIT I   PARTIAL DIFFERENTIAL EQUATIONS   9+3

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT II   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   9+3

Classification of partial differential equations – Fourier series – Half range Fourier sine and cosine series - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction in Cartesian form (excluding insulated edges) – Steady state solution two dimensional heat equation in polar form (circular, semicircular and quadrant plate).

UNITIII   SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS   9+3

Solution of algebraic and transcendental equations: Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Gauss Seidel Iterative methods - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

UNIT IV   INTERPOLATION AND APPROXIMATION   9+3

Interpolation with unequal intervals - Lagrange's interpolation – Method-Newton's divided difference interpolation – Finite difference operators and its relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT V   INITIAL AND BOUNDARY VALUE PROBLEMS IN DIFFERENTIAL EQUATIONS   9+3

Finite difference solution of ordinary differential equations - Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on

rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Express proficiency in handling higher order partial differential equations	
2.	Develop skills in classification, formulation, solution, and interpretation of partial differential equations model	
3.	Have the fundamental knowledge of solving an algebraic or transcendental equation, linear system of equations.	
4.	Appreciate the numerical techniques of interpolation in various intervals.	
5.	Solve boundary value problems using finite difference method.	

TEXTBOOKS:

1. Grewal .B.S, Grewal .J.S "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, New Delhi, 2015.
2. Kandasamy. P, Thilagavathy. K and Gunavathy. K., "Engineering Mathematics Volume III", 4th Edition, S. Chand & Company ltd, New Delhi, 2008.
3. Grewal. B.S. and Grewal. J.S., Numerical methods in Engineering and Science, Khanna Publishers, 11th Edition, New Delhi, 2017.
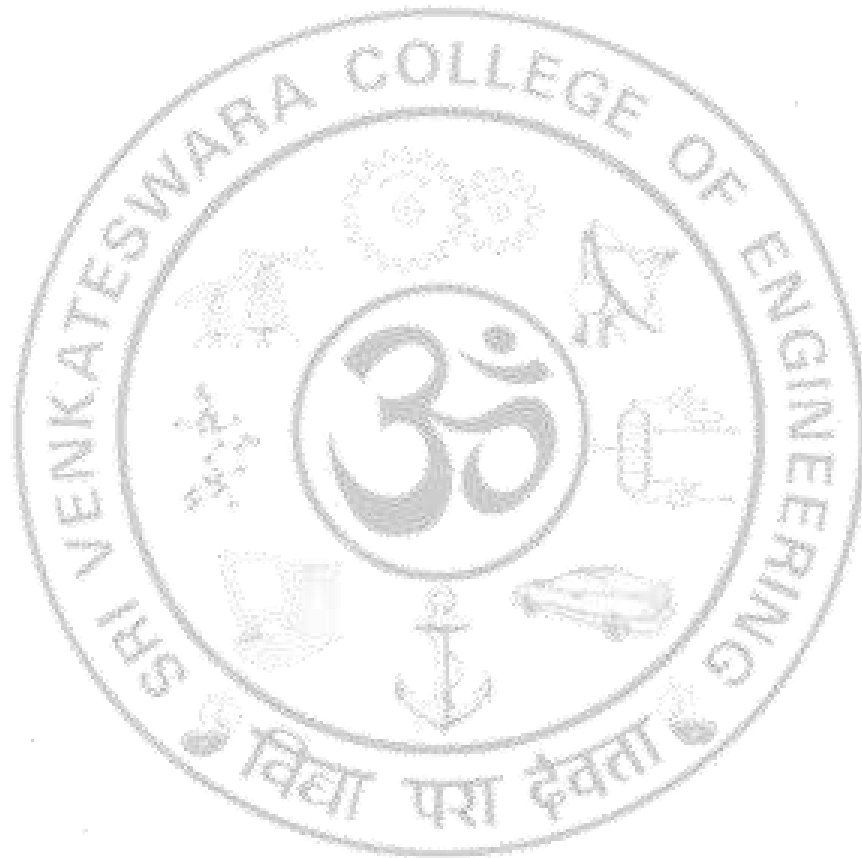
REFERENCE BOOKS:

1. Erwin Kreyszing, Herbert Kreyszing, Edward Norminton, "Advanced Engineering Mathematics", 10th Edition, John Wiley, 2015.
2. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", 9th edition, Laxmi Publications (p) Ltd., 2014.
3. Sankara Rao. K., Numerical methods for Scientists and Engineers, Prentice Hall of India Private, 3rd Edition, New Delhi, 2007.
4. Venkataraman. M.K. Numerical Methods in Science and Engineering, National Publishers, 2001.

WEBLINKS:

1. https://nptel.ac.in/courses/111107111
2. https://nptel.ac.in/courses/111/107/111107105/
3. https://nptel.ac.in/courses/111/107/111107063/

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2											
CO2	3	3	2	2											
CO3	3	3	2	2											
CO4	3	3	2	2											
CO5	3	3	2	2											

BT22301	STOICHIOMETRY & PROCESS CALCULATIONS	L	T	P	C
		2	1	0	3

OBJECTIVES:

1. To recall different system of units and relate its conversions.

2. To study about the basic chemical calculations and their applications.

3. To explain the concept of material balance and relate its outcomes.

4. To apply the concept of material balance in various unit operations.

5. To explain the concept of energy balance and relate its outcomes.

UNIT I	**INTRODUCTION TO STOICHIOMETRY**	**4+2**

Dimensions and system of units, Fundamental and derived units, Unit conversions and its significance, Balancing the equations, Basic unit operations.

UNIT II	**BASIC CHEMICAL CALCULATIONS**	**8+2**

Mole concept: atomic weight, molecular weight and equivalent weight. Molarity, molality, normality, ppm, mole percent, mass percent, and volume percent. Density, Viscosity, Specific gravity and Surface tension. Gases: Gas laws, Average molecular weight and density.

UNITIII	**MATERIAL BALANCE WITHOUT CHEMICAL REACTIONS**	**6+3**

Process flowsheet, Degree of freedom, Material balance with and without recycle; Bypass and purge streams, Material balance without chemical reactions: Dryer, Evaporator, Extractor, and Distillation column.

UNIT IV	**MATERIAL BALANCE WITH CHEMICAL REACTIONS**	**6+4**

Concept of limiting and excess reactants, percentage conversion, yield, selectivity, Material balance with chemical reactions - single and multiple reactions, Application of material balance in bioprocesses.

UNIT V	**CONCEPTS IN ENERGY BALANCES**	**6+4**

Law of conservation of energy and Energy balance equation, Heat capacity of solids, liquids and gases, Sensible and latent heat, Hess's law, Laws of thermodynamics, Standard heat of reaction: formation and combustion, Enthalpy determination, Thermodynamic aspects of Biological processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Differentiate different system of units and apply the unit conversions.	2
2.	Analyze various basic chemical calculations and its applications.	4

3.	Solve the material balance without chemical reactions.	3
4.	Apply the material balance concept in bioprocesses.	3
5.	Conceptualize energy balance without involving chemical reactions.	3

TEXTBOOKS:

1. "Stoichiometry", B.I. Bhatt, S.M. Vora, McGraw Hill Publishing Company Limited, 4th edition, 2004.

2. "Basic Principles & Calculations in Chemical Engineering", David M. Himmelblau, James B. Riggs, PHI Learing Pvt. Ltd, 7th edition, 2006.

3. "Elementary Principles of Chemical Processes", Richard M. Felder, Ronald W. Rousseau, Wiley, 3rd edition, 2004.

4. "Chemical Process Principles Part-I: Material and Energy Balances", O.A.Hougen, K.M.Watson, R.A.Ragatz, CBS Publishers New Delhi, 2nd edition, 2004.

REFERENCE BOOKS:

1. "Stoichiometry and Process Calculations", Narayanan, K.V. and Lakshmi Kutty PHI, 2006.

2. "Bioprocess Engineering Principles", Doran M Pauline, 2nd Edition, Elsevier, 2012.

3. "Unit Operations of Chemical Engineering", McCabe, W.L., J.C. Smith and P.Harriot, 6th Edition, Mc Graw Hill, 2001.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2	3	3	2	3	2			1						3	2
CO3	3	3	2	3	2									3	
CO4	3	3		3	2			1						3	
CO5			2	3		1	1		2			1	1	3	2

1-Weak; 2-Moderate; 3-Strong.

L	T	P	C
3	0	0	3

BT22302　　　　　　**MICROBIOLOGY**

OBJECTIVES:

1. To introduce students to the isolation and staining of microbes.

2. To help them to understand the morphological differences and reproduction.

3. To support them to know the pattern of growth and nutritional requirement for growth.

4. To solve the problems in microbial infection and their control.

5. To apply the microbial nature of behavior to bring about solution to the environmental pollution issues.

UNIT I　　　　　**ISOLATION AND STAINING**　　　　　**9**

Basics of microbial existence, History of microbiology, Classification and Nomenclature of microorganisms, Microscopic examination of microorganisms, Light and electron microscopy, Principles of different staining techniques like gram staining, acid-fast, capsular staining, flagellar staining. Sources and isolation of Industrially important microbes.

UNIT II　　　**MICROBES, STRUCTURE AND MULTIPLICATION**　　　**9**

Structural organization and Multiplication of bacteria, viruses, algae and fungi with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages. microbiology of water, air and soil, Strain improvement.

UNIT III　　　**MICROBIAL NUTRITION, GROWTH AND METABOLISM**　　　**9**

Nutritional requirements of bacteria, Different media used for bacterial culture, Growth curve and different methods to quantify bacterial growth, aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules. Media formulation, Microbial communication system, Probiotics.

UNIT IV　　　**CONTROL OF MICROORGANISMS AND PRESERVATION OF STRAINS**　　　**9**

Physical and chemical control of microorganisms, Host, microbe interactions, Anti-bacterial, Antifungal and Anti-viral agents, Mode of action and resistance to antibiotics, Clinically important microorganisms. Preservation and maintenance of industrially important strains.

UNIT V　　　**INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**　　　**9**

Bioremediation, Bioleaching, Bioreduction, Biotransformation, Vermicomposting Biofertilizers and Biopesticides, Microorganisms and Pollution control, Biosensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.	2
2.	To apply basic biotechnological principles, methods and models to solve biotechnological tasks.	3
3.	To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.	3
4.	To design and deliver useful modern biotechnology products to the Society	5
5.	To understand the significance of industrial and environmental microbiology	2

TEXTBOOKS:

1. Talaron K., Talaron A, Casita P and Reid, "Foundations in Microbiology", 1st Edition,W.C. Brown Publishers, 1993.

2. Pelczar M.J, Chan E.C.S and Krein N.R, Microbiology, 5th Edition, Tata McGraw Hill Edition, 2012.

3. Prescott L.M, Harley J.P and Klein D.A, "Microbiology", 3rd Edition, W. C. Brown Publishers, 1996.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2		2	2	3	3	3		3		2	3
CO2	2	3		2		2			2			3	3	3	2
CO3	3	2	3	3	2	2	3				3	2	2	2	3
CO4	3	2	2	3	2		2			2		3	3	3	
CO5	2	2	3	3	3		3		2			3	3	3	

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
BT22303 BIOCHEMISTRY	3	0	0	3

OBJECTIVES:

1. To acquire the fundamental knowledge on functional aspects of amino acids, protein, and enzymes.

2. To impart knowledge on the classification and metabolism of carbohydrates.

3. To impart knowledge on the metabolism of fatty acids.

4. To provide an insight on the different metabolic pathways and the energy production.

5. To illustrate the synthesis and metabolism of amino acid and nucleic acid.

UNIT I	DOGMA OF BIOMOLECULES	9

Importance of biochemistry in medicine, Tendency of water in group transfer, Implications of pH, pK and buffers, Classification, Structural and functional properties of amino acids, proteins and enzymes, cofactors and coenzymes.

UNIT II	METABOLISM OF CARBOHYDRATES	9

Classifications of Carbohydrates, Biological Significance of Monosaccharides, Oligosaccharides and polysaccharides. Metabolism of Carbohydrates – Glycolysis, Citric Acid Cycle, pentose phosphate pathway, gluconeogenesis, glycogenesis and glycogenolysis.

UNIT III	METABOLISM OF FATTY ACIDS	9

Classification of lipids, biological significance of Essential Fatty Acids, Triglycerides, Phospholipids and Sterols. Metabolism of lipids, Oxidation of fatty acids, β – oxidation, Biosynthesis of Ketone bodies & Cholesterol.

UNIT IV	BIOENERGETICS	9

Bioenergetics and the role of ATP, Biological oxidation, Respiratory chain, Chemiosmotic Theory, Oxidative Phosphorylation, Uncouplers, Calculation of ATP during oxidation of glucose and Fatty acid.

UNIT V	METABOLISM OF AMINO ACIDS AND NUCLEIC ACIDS	9

Biosynthesis of essential Amino acids, Nitrogen balance, Urea cycle, Biosynthesis of purine and pyramidine and their catabolism.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Demonstrate the basic concepts and their implementation in the functional prospects of biomolecules	2
2.	Explain the structure of carbohydrates and their application in	2

biological process.

3.	Relate the structure of lipids and their application in biological process	2
4.	Utilize the concepts of bioenergetics and the energy production in the cellular respiration.	3
5.	Correlate the functional principles of biomolecules in the metabolism of amino acids and nucleic acids	3

TEXTBOOKS:

1. David L. Nelson and Michael M. Cox, "Lehninger's Principles of Biochemistry", 7th Edition, W. H. Freeman Publisher, 2017.
2. Donald Voet, "Fundamentals of Biochemistry", 5th Edition, John Wiley Publishers, 2016.
3. Thomas M. Devlin, "Biochemistry with Clinical Correlations", 7th Edition, John Wiley and Sons, 2011.
4. Murray R.K., David, A, Bender, Kathleen M, Botham, Peter J. Kennelly, Victor W. Rodwell, P Anthony P, Weil D.K and Mayes P.A, "Harpers illustrated Biochemistry", 28th Edition, Mc Graw Hill publishers, 2009.
5. Stryer L, "Biochemistry". 5th Edition, W. H. Freeman and company, 2002.

REFERENCE BOOKS:

1. Carl A. Burtis, Edward R. Ashwood and David E. Bruns (eds): Textbook of Clinical Chemistry and Molecular Diagnosis (5th edition)
2. John W Baynes, Marek H. Dominiczak, and Hab Med, "Medical Biochemistry", ELSEVIER Publications, 2018.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	2						3	1	3	2
CO2	3	2	2	3	1	2						3	1	3	2
CO3	3	2	2	3	1	2						3	1	3	2
CO4	3	2	2	3	1	2						3	1	3	2
CO5	3	2	2	3	1	2						3	1	3	2

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
BT22308	**BASIC INDUSTRIAL BIOTECHNOLOGY: THEORY AND PRACTICES**	2	0	2	3

OBJECTIVES:

1. To make the students aware of the overall industrial bioprocess so as to help them to meet the requirement of the industrial needs.

2. The course prepares the students for the bulk production of commercially important primary and secondary metabolites such as organic acids, amino acids, alcohols, antibiotics and industrial enzymes.

3. The course introduces bioreactors, its types, operation methods and provides an experimental demonstration of the same.

4. The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products, which have a huge industrial significance.

5. The course provides the knowledge on plant and animal cell cultures for the production of modern biotechnology products.

UNIT I   INTRODUCTION TO INDUSTRIAL BIOPROCESS   6+6

Fermentation, Traditional and modern Biotechnology, A brief survey of organisms, processes, products, Basic concepts of upstream and downstream processing in Bioprocess, Bioreactor and its types.

1. Preparation of inoculum media and production media
2. Production of traditional fermentation products

UNIT II   PRODUCTION OF PRIMARY METABOLITES   6+6

Primary metabolites: Production of commercially important primary metabolites, organic acids, amino acids and alcohol.

1. Production of alcohol from yeast
2. Production of organic acid from agricultural waste

UNIT III   PRODUCTION OF SECONDARY METABOLITES   6+6

Secondary metabolites: Production of commercially important secondary metabolites, antibiotics, steroids, and industrial enzymes.

1. Analysis of antibiotic activity by well diffusion/disc diffusion method
2. Production of enzyme by batch fermentation method

UNIT IV   PRODUCTION OF OTHER BIOPRODUCTS   6+6

Production of biopesticides, biofertilizers, biopolymers, biodiesel, and SCP.

1. Production of bioploymer by batch fermentation method
2. Production of biodiesel

UNIT V   MODERN BIOTECHNOLOGY PRODUCTS   6+6

Production of recombinant proteins having therapeutic and diagnostic applications, Bioprocess strategies in plant cell and animal cell culture.

1. Plant cell culture techniques

2. Animal cell culture techniquesPrimary cell culture techniques

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.	2
2.	To apply basic biotechnological principles, methods and models to solve biotechnological tasks.	3
3.	To identify and debate the ethical, legal, professional issues in the field of biotechnology.	2
4.	To design and deliver useful modern biotechnology products to the society.	3
5.	To learn the hands on experiment on isolation of product producing microorganisms and production of bioproducts.	4

TEXTBOOKS:

1. Satyanarayana U, "Biotechnology", Books & Allied, 2005.

2. Dubey, R.C, "A Textbook of Biotechnology", S. Chand & Co., 2006.

3. Kumar H.D, "A Textbook on Biotechnology", 2nd Edition, Affiliated East West Press, 1998.

4. Balasubramanian D, "Concepts in Biotechnology", Universities Press, 2004.

5. Ratledge Colin and Bjorn Kristiansen, "Basic Biotechnology" 2nd Edition, Cambridge University Press, 2001.

REFERENCE BOOKS:

1. Cruger,Wulf and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing, 2000.

2. Presscott S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios, 2005.

3. Moo Young Murrey, "Comprehensive Biotechnology", Bryce and Mansi, 1999.

4. Stanbury P.F, Whitaker A and Hall S.J, "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.

5. Ramawat K.G. and Shaily Goyal, "Comprehensive Biotechnology", S. Chand publications, 2009.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					3							3	
CO2	3	3				3	3					3	2	3	
CO3	3	3	3	3	3	3	3	1				3		3	
CO4	3	3	3	3	3	3	3					3	2	3	2
CO5	3	3	3	3	3				1		1	3		3	2

1-Weak; 2-Moderate; 3-Strong.
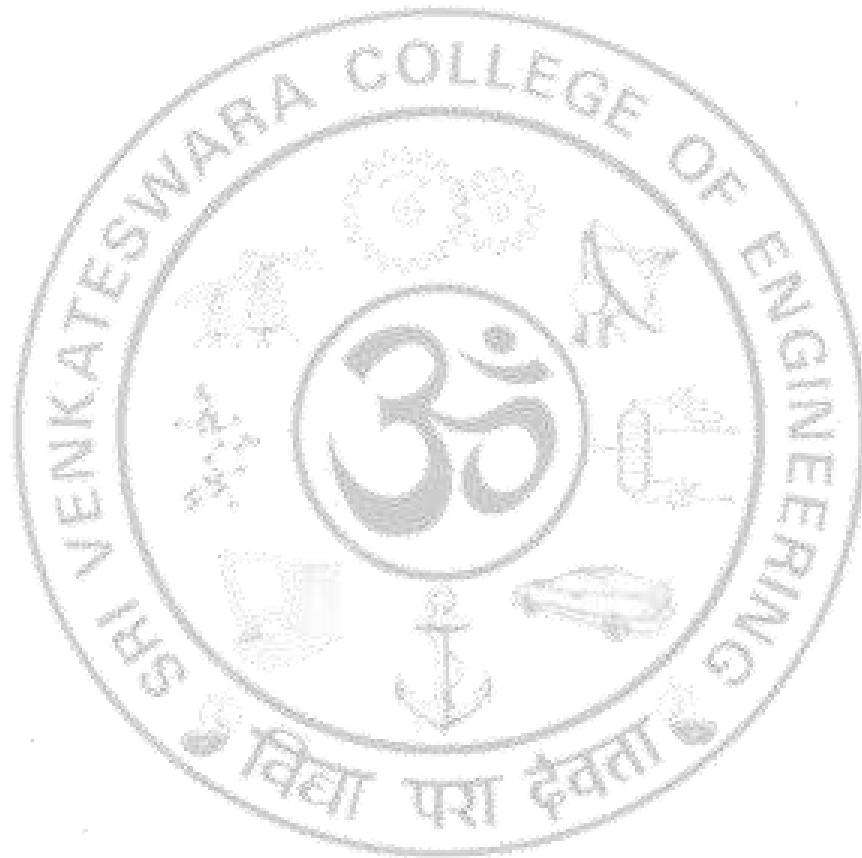
	L	T	P	C
BT22309 **CELL BIOLOGY: THEORY AND PRACTICES**	2	0	2	3

OBJECTIVES:

1. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells.

2. To become familiar with the role of cellular components in cell division.

3. To possess broad knowledge of the molecular interaction between cells.

4. To demonstrate a clear understanding between secondary messenger and signal transduction mechanism.

5. To develop skills in the working principles of microscopy and identification of cell based on morphology.

UNIT I   CELL STRUCTURE & FUNCTION   6+6

Sub-cellular structures, chromatin organization and organelles functions. Cytoskeletal proteins. Cell - Cell junctions.

Visualization of prokaryotic and eukaryotic cells;

Staining and Visualisation of Mitochondria;

Preparation of blood smear and differential staining of blood cells.

UNIT II   CELL DIVISION   6+6

Mitosis, Meiosis, Cell cycle - regulation - checkpoints - mitosis promoting factors – cyclins and cyclin-dependent kinases.

Identifying the various divisional stages in Mitosis

Observation of growth and differentiation in single cells

UNIT III   CELL MEMBRANE TRANSPORT   6+6

Membrane Structure and organisation. - pumps - channels transporters and receptors; types of membrane Transport, Osmosis and Ion channels, ATP pumps. Na^+ / K^+ /Ca^{+2} pumps;

Osmosis and Tonicity;

Cell Viability - Trypan Blue Assay.

Cell Proliferation Assay - MTT assay.

UNIT IV   CELL COMMUNICATION   6+6

Signal transduction; Extracellular signalling: autocrine/paracrine/endocrine models. Receptors – Cell surface / cytosolic receptors and examples, GPCR - RTKs and ion channel. Secondary messengers – adenylate cyclase - calcium flux - phospholipases - protein kinases molecules.

Buffer & Culture media preparation and sterilization; Culturing of plant and animal cells; Cryopreservation of cell culture;

UNIT V   CELL CULTURE TECHNIQUES   6+6

Flow cytometry, FACS, SEM, TEM Confocal Microscopy and Fluorescence

Microscopy

Measurement of Onion epidermal cell using Trinocular Microscope

Separation of Peripheral Blood Mononuclear Cells from blood.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells.	3
2.	To become familiar on different stages of the cell cycle and mitosis in onion root tip.	3
3.	To possess practical knowledge of basic membrane transport techniques like osmosis and tonicity	3
4.	To demonstrate a clear understanding between secondary messengers and signal transduction mechanism	3
5.	To develop skills on working principles of microscopy and separation of PBMC.	3

TEXTBOOKS:

1. Bretscher, A., Kaiser, C. A., Amon, A., Berk, A., Ploegh, H., Lodish, H., Martin, K. C., Krieger, M. (2016). Molecular Cell Biology. United Kingdom: W. H. Freeman.

2. Alberts, B., Hopkin, K., Johnson, A. D. (2019). Essential Cell Biology. United Kingdom: W.W. Norton.

3. Alberts, B. (2017). Molecular Biology of the Cell. United States: W.W. Norton.

4. Cooper, G. M., Cooper, G. (. o. B. (2019). The Cell: A Molecular Approach. United Kingdom: Oxford University Press, Incorporated.

5. Dickey, J., Simon, E. (2019). Campbell Essential Biology, Global Edition. United Kingdom: Pearson.
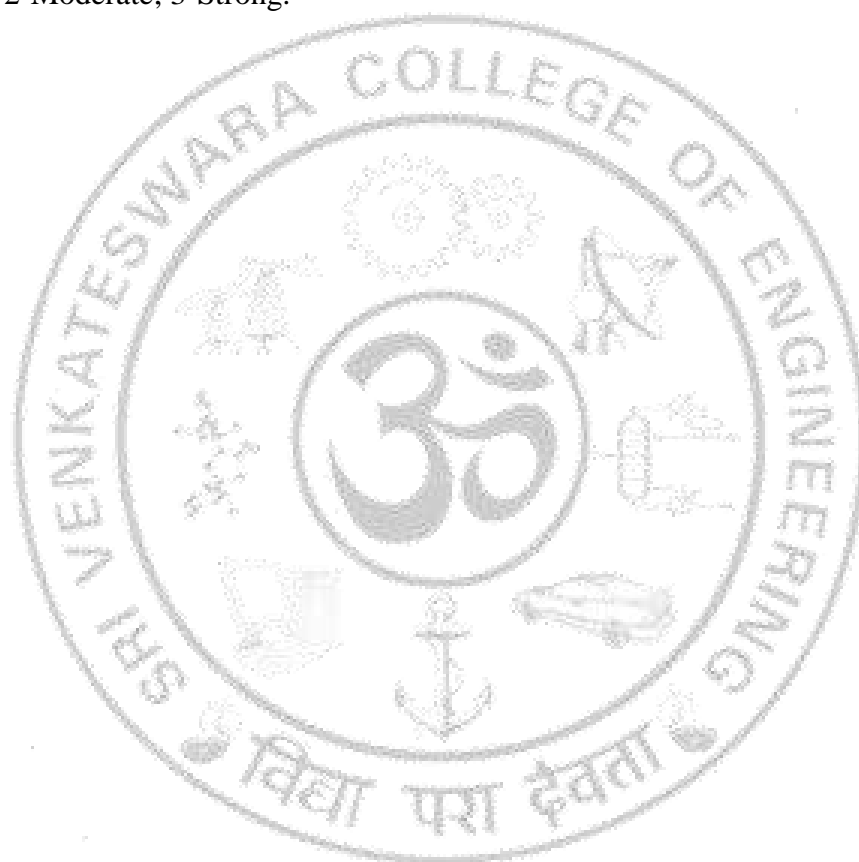
REFERENCE BOOKS:

1. Watson, J. D., Losick, R., Baker, T. A., Bell, S. P., Gann, A., Levine, M. (2014). Molecular Biology of the Gene. United Kingdom: Pearson.

2. Jones, P., Owen, J. A., Stranford, S., Punt, J. (2018). Kuby Immunology. United Kingdom: Macmillan Learning.

3. Singh, B. R., Kumar, R. (2022). Practical Techniques in Molecular Biotechnology. India: Cambridge University Press.

4. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. (2018). United Kingdom: Cambridge University Press.

5. Shephard, E. A., Townsend-Nicholson, A., Hyams, J. S., Patel, S., FitzHarris, G., Bolsover, S. R. (2022). Cell Biology: A Short Course. United Kingdom: Wiley.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	2	2		2	2	3	3	3		3		2	3
CO2	2	3		2		2			2			3	3	3	2
CO3	3	2	3	3	2	2	3				3	2	2	2	3
CO4	3	2	2	3	2		2			2		3	3	3	
CO5	2	2	3	3	3		3		2			3	3	3	

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
BT22311 **MICROBIOLOGY LABORATORY**	0	0	4	2

OBJECTIVES:

1. To acquire skills in microscopy and their handling techniques and staining procedures

2. To understand the various media required for microbial growth and sterilization techniques

3. To learn the staining techniques and culturing of microorganisms.

4. To demonstrate various techniques to learn the morphology, identification and propagation of cells and microbes.

5. To understand the distribution and role of microorganisms in different habitats.

LIST OF EXPERIMENTS

1 Introduction, Good Laboratory Practices, Safety, Handling of Micropipette

2 Sterilization Techniques.

3 Culture Media - Preparation of Nutrient broth and agar; flask and test tubes, slants and stabs.

4 Culturing Techniques – Aerobic and anaerobic culture methods.

5 Staining Techniques – Simple and Differential Staining.

6 Microbiologic sample collection procedures from the environment

7 Microbial enumeration techniques – Pour plate (Direct Microscopy) and Surface spread (Turbidity) methods

8 Quantification of microbes: Serial Dilution, Viable count determination – CFU

9 Effect of Disinfectants- Phenol Coefficient;

10 Minimal Inhibition Concentration assay; Antibiotic Sensitivity of Microorganisms

11 Growth Curve Determination in Bacteria and Yeast

12 Effect of pH, Temperature and UV on the growth of bacteria

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism.	3
2.	Know the various aseptic techniques and sterilization methods.	3
3.	Develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory.	3

4.	Learn the various techniques of culturing of microorganisms and media preparation.	3
5.	Study the growth of microorganisms by varying the growth conditions	3

REFERENCE BOOKS:

1. Welsh, C., Cappuccino, J. (2019). Microbiology: A Laboratory Manual. United Kingdom: Pearson.

2. Sattley, W. M., Stahl, D. A., Madigan, M. T., Buckley, D. H., Bender, K. S. (2018). Brock Biology of Microorganisms. United Kingdom: Pearson.

3. Arora, B., Arora, D. R. (2020). Practical Microbiology. India: CBS Publishers & Distributors.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3		3	2	3			3	3	2	3	3	3	3
CO2		3	2	3			2	2	2	3	3	3	3	3	3
CO3	2	3	3	3	2			3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
BT22312 **BIOCHEMISTRY LABORATORY**	0	0	4	2

OBJECTIVES:

1. To apprise the knowledge on molarity, molality and normality for solution/reagents preparation.

2. To learn and understand the principles behind the qualitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,)

3. To learn and understand the principles behind the quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,)

4. To perform Laboratory analysis of the biomolecules in the body fluids.

5. To understand the working principle of spectroscopy

LIST OF EXPERIMENTS

1. Preparation and measurement of pH of standard buffers
2. Qualitative analysis of carbohydrates
3. Qualitative analysis of proteins
4. Qualitative analysis of lipids
5. Quantitative analysis of proteins
6. Quantitative analysis of carbohydrates
7. Quantitative analysis of lipids
8. Estimation of bilirubin in serum
9. Estimation of creatinine in urine or serum
10. Estimation of chloride in urine
11. Estimation of ammonia in urine
12. Quantitative analysis of urea in urine

TOTAL: 60 PERIOS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Find the hazardous chemicals and safety precautions in case of emergency.	1
2.	Interpret the qualitative and quantitative methods for estimation of biomolecules.	3
3.	Make use of spectroscopy techniques in biochemical analysis of biomolecules.	3
4.	Make use of biochemistry experiments and methods in research and clinical sample analysis.	2

5. Distinguish various methods available for analysis of biomolecules 3

REFERENCE BOOKS:

1. Gupta R.C and Bhargavan S, "Practical Biochemistry", CBS Publishers and Distributors,1985.

2. David T. P, "Introduction of Practical Biochemistry", 3rd Edition, Tata McGraw Hill Publishing Company Limited, 2008

3. Murray R.K, Granner D.K, Mayes P.A and Rodwell V.W, "Harpers Biochemistry", 25th Edition, Appleton and Lange, 2000.

4. Thomas M. D, "Textbook of Biochemistry with clinical correlations", 6th Edition, WileyLiss Publishers, 2006.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						3	1		1					3	3
CO2	2	3		3										3	3
CO3	2			3										3	
CO4		3	2	3	2	3		1				2	2		3
CO5		3	2	3	2	3						2	2	3	3

1-Weak; 2-Moderate; 3-Strong.

MA22451	INTRODUCTION TO BIOSTATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

1. To use basic statistical methods such as descriptive statistics, graphical plots to analyze real world problems arising in medical science, public health, and biology.
2. To apply the concepts of probability and random variables to model and analyze problems in biological sciences.
3. To understand and apply the concepts of two dimensional random variables, regression models and their applications.
4. To understand and use hypothesis testing to analyze problems in biological sciences.
5. To acquire knowledge in Statistical Quality Control and use it effectively in various models.

UNIT I   **DESCRIPTIVE STATISTICS**   **9+3**

Data representation and plotting - Measures of Central Tendency - Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles - Measure of Dispersion – Range, Standard Deviation, Coefficient of Variation - Moments, Skewness, Kurtosis - Curve fitting – Method of Least Squares.

UNIT II   **BASICS OF PROBABILITY**   **9+3**

Random Experiment, Sample space, Outcomes and Events, Axioms of Probability, Counting techniques, Conditional Probability, Independent Events, Bayes' Theorem, Random Variables, PMF, PDF, Expectation and Variance of Random Variables, Binomial, Poisson, Exponential and Normal Random Variables.

UNITIII   **TWO DIMENSIONAL RANDOM VARIABLES**   **9+3**

Joint distributions – Marginal and conditional distributions – Functions of two-dimensional random variables – Correlation - Regression curve – Central Limit Theorem (for independently and identically distributed random variables).

UNIT IV   **TEST OF HYPOTHESIS**   **9+3**

Sampling distributions, Estimation of parameters, Statistical hypothesis, Large sample test based on Normal distribution for single mean and difference of means and proportion, Tests based on t, and F distributions for mean and variance, Chi-square test for Goodness of fit, Contingency table (test for independence).

UNIT V   **STATISTICAL QUALITY CONTROL**   **9+3**

Control charts for measurements (X and R charts), Control charts for attributes (p, c and np charts), Tolerance limits, Acceptance sampling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL

1. Have an in depth understanding of the various concepts that are used in biological models.
2. Understand and apply the concepts of probability and random variables in the study of biological models.
3. Apply the concepts of two dimension random variables and extend the same to multiple random variables.
4. Frame suitable hypothesis and test the same using the appropriate test.
5. Apply statistical quality control methods on real time problems.

TEXTBOOKS:

1. Spiegel M R, david P Lindstrom, Schaums Easy Outline Of Statistics, McGraw Hill India, 2020.
2. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand, 11th edition, 2005
3. Richard A J, Irwin Miller, John Freund, Miller and Freund's - Probability and Statistics for Engineers, Pearson Education, Asia, 9th Edition, 2020.

REFERENCE BOOKS:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Spiegel M R, Schiller J and Srinivasan R A, Schaum Outline of Theory and Problems of Probability and Statistics, Tata McGraw Hill Edition, 2004.

WEBLINKS:

1. https://towardsdatascience.com/intro-to-descriptive-statistics-and-probability-for-data-science-8effec826488
2. https://online.stat.psu.edu/statprogram/reviews/statistical-concepts/hypothesis-testing

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2								2			
CO2	3	3	2												
CO3	3	3	2									2			
CO4	3	3	2	2								2		2	2
CO5	3	3	2	2								2		2	2

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
GE22451	**ENVIRONMENTAL SCIENCES AND SUSTAINABILITY** **(Common to all Branches)**	3	0	0	3

OBJECTIVES:

1. To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize the biodiversity of India and its conservation.

2. To impart knowledge on the causes, effects and control or prevention measures of environmental pollution.

3. To study and understand the various types of renewable sources of energy and its applications.

4. To familiarize the concept of sustainable development goals, economic and social aspects of sustainability, recognize and analyze climate changes, and environmental management challenges.

5. To inculcate and embrace sustainability practices, develop a broader understanding of green materials and energy cycles, and analyze the role of sustainable urbanization.

UNIT I   ENVIRONMENT AND BIODIVERSITY   9

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– food chains, food webs and ecological pyramids, ecological succession. Biodiversity- types- genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: fragmentation and habitat loss, poaching of wildlife, human-wildlife conflicts – endangered and endemic species of India –conservation of biodiversity: In-situ and ex-situ.

UNIT II   ENVIRONMENTAL POLLUTION   9

Definition, causes, effects and preventive measures of air, water and soil pollution. Marine and thermal pollution - causes, effects and control measures. Light and noise pollution - effect on flora and fauna. Nuclear pollution- Sources, effects and control measures. Disposal of radioactive wastes (Nuclear hazards). Pollution case studies. Role of an individual in the prevention of pollution. Solid, hazardous and E-waste management. Occupational health and safety management system (OHASMS). Environmental protection, Environmental protection acts, categorization of spices according to IUCN.

UNIT III   RENEWABLE SOURCES OF ENERGY   9

Energy resources: Growing energy needs, Nonrenewable resources – types, uses. Energy management and conservation - New energy sources, Need of new sources - geo suitability of establishing renewable energy sources, different types new energy sources. Applications of hydrogen energy, ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Role of an individual in conservation of energy.

UNIT IV   SUSTAINABILITY AND MANAGEMENT   9

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium

development goals, and protocols, Sustainable Development Goals-targets, indicators and intervention areas - Principles of green chemistry, Climate change- Global, Regional and local environmental issues and possible solutions-case studies - Role of non-governmental organization, Concept of carbon credit, carbon footprint - Environmental management in industry - A case study

UNIT V   SUSTAINABILITY PRACTICES   9

Zero waste and R concept, circular economy, ISO 18000 series, material life cycle assessment, environmental impact assessment. Wasteland reclamation, Sustainable habitat: green buildings, green materials, energy efficiency and energy audit, sustainable transports. Energy cycles, carbon cycle, emission and sequestration, Green engineering: sustainable urbanization- socio-economical and technological change. Rainwater harvesting, watershed management, environmental ethics: Issues and possible solutions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Recognize the fundamental role of ecosystems and suggest an appropriate method for the conservation of biodiversity.	3
2.	Describe the different types of pollution, their effects and strategies to control pollution.	3
3.	Identify the various renewable energy resources and use the appropriate one thereby conserving non-renewable resources for future generation.	3
4.	Explain the various goals of sustainable development applicable to suitable technological advancement and societal development.	2
5.	Summarize the various sustainability practices, green materials, energy cycles, and the role of green engineering in sustainable urbanization.	2

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 7th Edition, New Age International Publishers, 2022.

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.

3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Pearson. 2011.

5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, CL Engineering, 2015.

6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.

7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.

3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 3rd edition, 2015.

5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 3rd edition, 2021.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					3	3	2		2		1			
CO2	3					3	3	2		2		2			
CO3	3		1			3	3	1		2		1			
CO4	3					3	3	3		2		2			
CO5	3					3	3	3		2		2			

1-Weak; 2-Moderate; 3-Strong.

	L	T	P	C
BT22401	**3**	**0**	**0**	**3**

ANALYTICAL TECHNIQUES AND INSTRUMENTATION

OBJECTIVES:

1. To acquire fundamental knowledge about the light spectrum and basic components of optical instruments.

2. To impart the principle and applications of different types of absorption and fluorescence spectroscopy.

3. To prepare the students familiarize in the field of NMR and Mass spectroscopy.

4. To acquaint the student with different chromatographic methods for separation of biological products.

5. To gain the knowledge on separation of proteins, DNA using electrophoresis and structure determination of molecules through surface microscopy.

UNIT I **INTRODUCTION TO SPECTROMETRY** **9**

Properties of electromagnetic radiation, wave properties, Components of optical instruments, Sources of radiation, Wavelength selectors, Sample containers, Radiation transducers, Signal process and read outs, Types of optical instruments.

UNIT II **MOLECULAR SPECTROSCOPY** **9**

Molecular absorption spectrometry, Beer's law, Theory of UV – visible absorption spectrometry, Instrumentation, Applications, Theory of fluorescence and Phosphorescence, Instrumentation, Applications, Theory of Infrared absorption spectrometry, IR instrumentation, Applications, Theory of Raman spectroscopy, Instrumentation, Application of FTIR and Raman spectroscopy in the analysis of biological samples.

UNIT III **MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY** **9**

Theory of NMR, Environmental effects on NMR spectra, Chemical shift, NMR spectrometers, Applications of ^{1}H and ^{13}C NMR, Molecular mass spectra, Ion sources, Mass spectrometer. Applications of molecular mass spectrometry, Electron paramagnetic resonance, g values, Instrumentation.

UNIT IV **SEPARATION METHODS** **9**

Equilibrium criteria for homogeneous chemical reactions, Evaluation of equilibrium General description of chromatography, Band broadening and optimization of column performance, Paper chromatography, Thin layer chromatography, Ion exchange chromatography, Size exclusion chromatography, Affinity chromatography-principles of GC and applications, HPLC, Applications of chromatography techniques in biotechnology and Biopharmaceutical industry**.**

UNIT V **ELECTROPHORESIS AND SURFACE MICROSCOPY** **9**

Introduction to electrophoresis, Types of electrophoresis, Agarose gel electrophoresis, Polyacrylamide gel electrophoresis, Study of surfaces, Scanning probe microscopes,

AFM and STM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Learn the working principle and application of spectroscopic methods used for biological products.	2
2.	Compare and study the principles and applications of mass spectrometry, nuclear magnetic and electron resonance spectroscopic techniques for various biological applications.	3
3.	Perceive with chromatographic techniques used in various industries such as Biotech/Biopharma/Food/ Etc.,	3
4.	Intrept the advanced microscopic methods for characterizing the biomolecules/ bioproducts.	3
5.	Separate the biomolecules using electrophoresis	2

TEXTBOOKS:

1. Skoog, D.A, James H. F and Stanly R. C, "Principles of Instrumental Analysis", 7th Edition, Cengage Learning, 2017.

2. Willard H. H, "Instrumental Methods of Analysis", 7th Edition, CBS, 2012.

3. Braun R. D, "Introduction to Instrumental Analysis", 2nd Edition Pharma Book Syndicate, 2012.

4. Ewing G.W, "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw, Hill, 2013.

REFERENCE BOOKS:

1. Sharma, B.K, "Instrumental Methods of Chemical Analysis: Analytical Chemistry", Goel Publishing House, 1972.

2. Haven Mary C. Laboratory Instrumentation. 4th Edition, John Wiley & Sons, 2017.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3					3							3	3
CO2	3	3		3	3		3					3	3	3	3
CO3	3	3		3	3		3					3	3	3	3
CO4	3	3		3	3		3					3	3	3	3
CO5	3	3	2	3	3	2	3					3	3	3	3

1-Weak; 2-Moderate; 3-Strong.

BT22402	TRANSPORT PHENOMENA OF BIOPROCESSES	L	T	P	C
		2	1	0	3

OBJECTIVES:

1. To study about the basics of fluids and fluid properties.

2. To understand the fundamental principles of fluid flow and mixing

3. To learn the mechanism of heat transfer in bioprocesses.

4. To study about different heat exchangers and their design.

5. To understand the basic concepts of mass transfer principles in bioprocess.

UNIT I   FLUIDS & FLUID PROPERTIES   6+3

Properties of Fluids-Specific weight, specific volume, specific gravity, viscosity; Newtons law of viscosity; Classification of Fluids-Non-Newtonian Fluids; Pressure and its measurement – Simple manometer, U-tube manometer and differential manometer; Viscosity Measurement; Factors affecting Broth Viscosity

UNIT II   FLUID FLOW AND MIXING   6+3

Fluids in Motion; Rheological properties of Fermentation Broths; Flow Measurement Devices; Pumps and Valves; Mixing Equipment; Flow Pattern in Agitated Tanks; Mechanism of Mixing; Mixing Time; Power Requirements for Mixing; Scale up of Mixing Systems; Effect of Rheological Properties on Mixing.

UNITIII   MECHANISM OF HEAT TRANSFER   6+3

Various modes of heat transfer-Conduction, Convection and Radiation; Steady state Conduction; Fourier's Law; Thermal conductivity; Combining Thermal Resistances in Series; Heat Transfer between Fluids; Thermal Boundary Layers; Individual and Overall Heat Transfer Coefficients; Fouling Factor.

UNIT IV   HEAT TRANSFER EQUIPMENTS   6+3

Heat-transfer configurations for bioreactors; Equipment for Heat Transfer: Double-pipe Heat Exchanger, Shell-and Tube- Heat Exchangers; Design Equations for Heat Transfer Systems; Logarithmic- and Arithmetic-Mean Temperature Differences; Calculation of Heat-Transfer Coefficients.

UNIT V   MASS TRANSFER   6+3

Molecular Diffusion; Fick's Law; Role of Diffusion in Bioprocessing; Film Theory; Convective Mass Transfer-Liquid-Solid Mass Transfer, Liquid-Liquid Mass Transfer, Gas-Liquid Mass Transfer; Oxygen Uptake in Cell Cultures; Oxygen Transfer in Fermenters; Measuring Dissolved-Oxygen Concentrations and Oxygen Solubility

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Understand the basic concepts of types of fluids and fluid properties.	2

		2.	Elaborate the concept of fluid flow and mixing in bioprocesses.	3

2. Elaborate the concept of fluid flow and mixing in bioprocesses.   3

3. Identify the different mechanisms of heat transfer in solids and fluids.   2

4. Illustrate the different types of heat exchangers used in industries,   2

5. Interpret the principles and applications of mass transfer in bioprocesses.   2

TEXTBOOKS:

1. Geankoplis, C.J., Transport Processes and Separation process Principles, 4th Edition, PHI, 2015.

2. Pauline M Doran, Bioprocess Engineering Principles, 2nd Edition, Academic Press, 2013.

3. Ghasem D.Najafpour, Biochemical Engineering and Biotechnology, 1st Edition, Elsevier, 2007

REFERENCE BOOKS:

1. J.M.Coulson and J.F.Richardson: Chemical Engineering VoI 1. Fluid flow, Heat Transfer and Mass Transfer. Butterworth,Heinemann, an imprint of Elservier, Sixth Edition, Indian Reprint, 2006.

2. Theodore L Bergman, Adrienne S Lavine, Frank P Incropera, David P DeWitt, Fundamentals of Heat and Mass Transfer, 7th Edition, Willey, 2011.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2	3	3	2	3	2			1						3	2
CO3	3	3	2	3	2									3	
CO4	3	3		3	2			1						3	
CO5			2	3		1	1		2			1	1	3	2

1-Weak; 2-Moderate; 3-Strong.

BT22403	CHEMICAL AND BIOCHEMICAL THERMODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. Explore the laws and applications of thermodynamics, types of energy, and property of fluids in biochemical systems.

2. Demonstrate the capability to analyze the energy attaining equilibria in solution thermodynamics.

3. Describe the criteria when two phases coexist in equilibrium in the vapor liquid equilibrium and liquid-liquid equilibria calculations

4. Describe the criteria when chemical reaction tends to attain chemical reaction equilibrium

5. Design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data in microbial growth, maintenance and product formation.

UNIT I	THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS	9

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behaviour, Maxwell's relations and applications, Estimation of thermodynamic properties using equations of state, Calculations involving actual property exchanges, Residual properties.

UNIT II	SOLUTION EQUILIBRIA	9

Partial molar properties concepts of chemical potential and fugacity, Ideal and non-ideal solutions, Concepts and applications of excess properties of mixtures, Activity coefficient, Gibbs Duhem equation.

UNIT III	PHASE EQUILIBRIA	9

Criteria for phase equilibria, VLE calculations for binary and multi component systems, Phase diagrams, Azeotropes and its types, Activity Coefficient Equations, Liquid- liquid equilibria

UNIT IV	CHEMICAL REACTION EQUILIBRIA	9

Equilibrium criteria for homogeneous chemical reactions, Evaluation of equilibrium constant, Effect of temperature and pressure on equilibrium constant, Calculation of equilibrium Conversion and yields for single and multiple reactions.

UNIT V	THERMODYNAMIC CYCLES AND BIOTHERMODYNAMICS	9

Carnot cycle, Refrigeration cycle, Thermodynamics of microbial growth, Stoichiometry, Thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Summarize the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems	3
2.	Identify the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.	3
3.	Identify the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations.	3
4.	Compare the criteria when chemical reaction tends to attain chemical reaction equilibrium.	3
5.	Design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of maintenance energy in microbial growth and product formation and to acquire knowledge on thermodynamic cycles.	4

TEXTBOOKS:

1. Narayanan K.V, "A Text Book of Chemical Engineering Thermodynamics", PHI, 2015.

2. Smith J.M, Van Ness H.C and Abbot M.M, "Chemical Engineering Thermodynamics", 7th Edition, McGraw-Hill, 2010.

3. Christiana D Smolke, "The Metabolic pathway engineering handbook fundamentals", CRC Press Taylor & Francis Group, 2010.

4. Nag, P.K, "Engineering Thermodynamics", 6th Edition, McGraw Hill Education, 2017.

5. Pandey G.N, Chaudhri J.C, "Chemical Engineering Thermodynamics", Khanna Publishers, 2004.
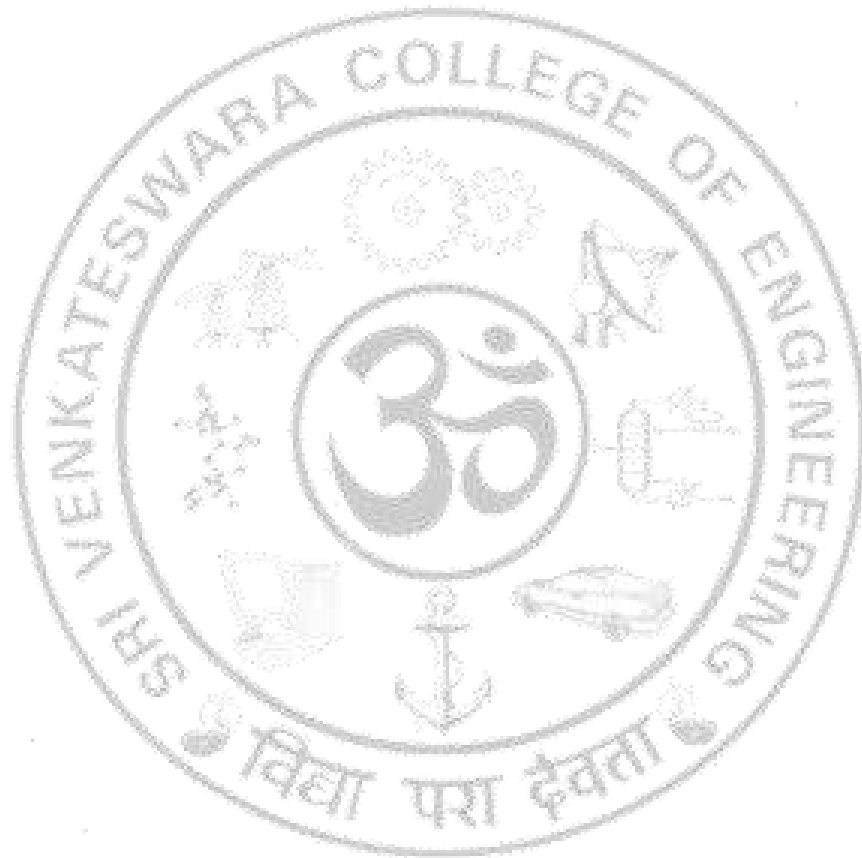
REFERENCE BOOKS:

1. Gopinath Halder, "Introduction to Chemical Engineering Thermodynamics", PHI, 2009.

2. Sandler S.I, "Chemical and Engineering Thermodynamics", John Wiley, 1989

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3							2		3	
CO2	3	3	3	3	3	2						2		3	
CO3	3	3	3	3	3	2									
CO4	3	3	3	3	3	2									
CO5	3	3	3	3	3									3	

1-Weak; 2-Moderate; 3-Strong.

BT22404   GENETICS AND MOLECULAR BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To explain the laws of inheritance.

2. To explain the role of alleles, allelism and epistasis.

3. To explain about the principle of DNA replication

4. To explain the steps involved in mRNA and protein production.

5. To explain the mechanism of gene regulation.

UNIT I   LAWS OF INHERITANCE   9

Laws of inheritance: Mendel's Laws - dominance, segregation, independent assortment; Chromosome theory of inheritance, Concept of alleles, types of dominance, lethal alleles, multiple alleles, test of allelism, complementation.

UNIT II   LINKAGE, MAPPING AND CHROMOSOMAL CHANGES   9

Epistasis, Linkage and Gene Mapping, Penetrance and Expressivity, Changes in Chromosome number and structure: Euploidy, Aneuploidy, chromosomal rearrangements - deletion, duplication, inversion, and translocation.

UNITIII   DNA REPLICATION AND REPAIR MECHANISM   9

DNA as a genetic material, Classical experiments by Griffith, Hershey and Chase, Avery, McLeod and McCarty. Biological significance, structure and physicochemical properties of elements in DNA and RNA. Overview of Central dogma- Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl semiconservative replication, Bidirectional DNA replication, theta replication, rolling circle replication. DNA mutations and repair mechanism.

UNIT IV   TRANSCRIPTION AND TRANSLATION   9

Structure and function of mRNA, rRNA and tRNA, Initiation, elongation and termination of RNA synthesis, Basic concepts in RNA world: Ribozymes, RNA processing: 5'- Capping, Splicing- Poly 'A' tail addition and base modification, Genetic code, Codon degeneracy- Wobble hypothesis and its importance- Prokaryotic and eukaryotic ribosomes- Steps in translation: Initiation, Elongation and termination of protein synthesis- Inhibitors of protein synthesis- Post translational modifications and its importance.

UNIT V   GENE REGULATION   9

Organization of genes in prokaryotic and eukaryotic chromosomes- Hierarchical levels of gene regulation, Inducible, Repressible operon, Prokaryotic gene regulation-lactose (lac), tryptophan (trp) and arabinose (ara) operon- Regulation of gene expression with reference to λ phage life cycle.

TOTAL: 45

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL

1.	Explain the various postulates of Mendel's Experiments and the principle of gene complementation.	2
2.	Relate the principle of recombination and linkage with gene mapping.	2
3.	Compare the different types of DNA replication mechanism.	4
4.	Identify the steps involved in transcription and translation.	3
5.	Infer the relationship between gene regulation and metabolism.	4

TEXTBOOKS:

1. Klug W. S. and Cummings M. R, "Concepts of Genetics", 12th Edition, Prentice Hall, 2019.

2. Benjamin A Pierce, "Genetics-a Conceptual Approach", 7th Edition, W H Freeman & Company, 2019.

3. Krebs, J. E., Goldstein, E. S., Kilpatrick, S. T, Lewin's GENES XII. Japan: Jones & Bartlett Learning, 2017.

REFERENCE BOOKS:

1. Freifelder, D., Cronan, J. E., Maloy, S. R Microbial genetics. Boston: Jones and Bartlett Publishers, 1994.

2. Lewis, J., Johnson, A., Alberts, B., Shamoo, A. E., Khin-Maung Gyi, F. A., Raff, M., Hunt., Walter, P., Roberts, K, Molecular Biology of the Cell. United Kingdom: Garland Science, 2002.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	2							2	3	2
CO2	1	2	2	3	3	3							2	3	2
CO3	2	1	1	1	3	3							1	2	1
CO4	2	1	1	1	3	1							1	2	1
CO5	2	2	3	2	3	3							1	3	3

1-Weak; 2-Moderate; 3-Strong.

		L	T	P	C
BT22411	**ANALYTICAL TECHNIQUES AND INSTRUMENTATION LABORATORY**	0	0	4	2

OBJECTIVES:

1. To understand the principles and applications of absorption spectroscopy.

2. To understand precision and accuracy of experiment using absorption spectroscopy.

3. To acquire experience in separating compounds using chromatography.

4. To understand the principles of nephelometry in estimation of compounds.

5. To get knowledge about the applications of fluorimetry.

LIST OF EXPERIMENTS

1 Precision and accuracy of an experiment using absorption spectroscopy.

2 Validation of Beer Lambert law using $KMnO_4$ solution.

3 Determination of pKa value of 4-nitrophenol using absorption spectroscopy

4 Determination of molar absorbtivity and stoichiometry of the Fe using 1, 10 phenanthroline.

5 UV spectra of nucleic acids.

6 Analysis of amino acids using Thin Layer Chromatography.

7 Analysis of plant pigments using column chromatography.

8 Limits of detection using aluminium alizarin complex.

9 Chemical actinometry using potassium ferrioxolate.

10 Estimation of SO_4^{2-} using Nephelometry.

11 Estimation of Al^{3+} using Fluorimetry.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

| CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Interpret Beer's and Beer Lambert's law and estimate various unknown compounds.	3
2.	Analyze UV and Visible spectroscopic techniques in estimating various compounds.	4
3.	Differentiate various chromatography techniques and separate various components.	3
4.	Apply the knowledge of fluorimeter in estimating various compounds.	3
5.	Estimate turbidity of any solution using nephelometry.	4

REFERENCE BOOKS:

1. Skoog, D.A. etal. "Principles of Instrumental Analysis", Vth Edition, Thomson / Brooks – Cole,1998

2.   Braun, R.D. "Introduction to Instrumental Analysis", Pharma Book Syndicate, 1987.

3.   Willard, H.H. etal. "Instrumental Methods of Analysis", VIth Edition, CBS, 1986.

4.   Ewing,G.W. "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2	3	3	2	3	2			2						3	2
CO3	3	3	2	3	2									3	
CO4	3	3		3	2			2						3	
CO5			2	3	2	2		2			2			3	2

1-Weak; 2-Moderate; 3-Strong.
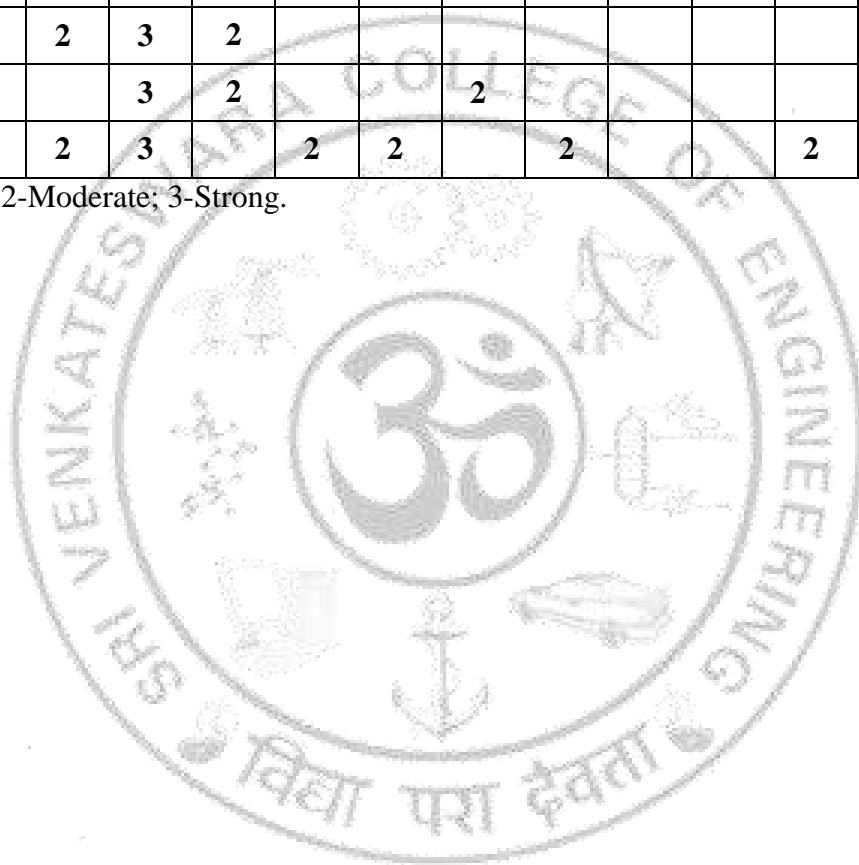
	L	T	P	C
BT22412 CHEMICAL ENGINEERING LABORATORY	0	0	4	2

OBJECTIVES:

1. To understand the principles and applications of flow measurement devices

2. To calculate the pressure drop in fluidized and packed bed reactors.

3. To study the principles of various industrial heat exchangers.

4. To perform filtration and calculate the resistances involved.

5. To separate components from the reaction mixture.

LIST OF EXPERIMENTS

1   Determination of flow rate and coefficient of discharge using Orificemeter

2   Determination of flow rate and coefficient of discharge using Venturimeter

3   Determination of flow rate of fluids using Rotameter

4   Determination of minimum fluidization velocity in Fluidized bed reactors

5   Determination of Pressure drop in Packed bed reactors

6   Determination of heat-transfer coefficient in Double-Pipe Heat Exchanger

7   Determination of heat-transfer coefficient in Shell and Tube Heat Exchanger

8   Determination of heat-transfer coefficient in Helical Coil Heat Exchanger

9   Determination of Filter cake and Medium resistance in Filtration using Leaf Filter

10   Verification of Rayleigh's Equation using Simple Distillation

11   Extraction of biological compounds using Soxhlet Apparatus

12   Adsorption of dyes using activated charcoal

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO	After completion of this course, the students will be able to	RBT LEVEL
1.	Determine the flow rates of fluids using various devices.	3
2.	Evaluate the pressure drop associated with fluidized and packed bed reactors.	3
3.	Differentiate various types heat exchangers used in industrial operations.	4
4.	Separate various components from reaction mixture using mass transfer principles.	3
5.	Evaluate the efficiency of various separation techniques involved in bioprocesses.	4

REFERENCE BOOKS:

1. McCabe W.L, Smith J.C and Harriot P, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2014.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3													3	
CO2	3	3	2	3	2			1						3	2
CO3	3	3	2	3	2									3	
CO4	3	3		3	2			1						3	
CO5			2	3	1	1		2				1	1	3	2

1-Weak; 2-Moderate; 3-Strong.