PAAVAI ENGINEERING COLLEGE, NAMAKKAL - 637 018

(AUTONOMOUS)

B.Tech. – BIOTECHNOLOGY

REGULATIONS 2019

(CHOICE BASED CREDIT SYSTEM)

(For the candidates admitted from the Academic Year 2022-2023)

SEMESTER III

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1.	HS	GE20301	தமிழரும்தொழில்நுட்பமும்/ Tamils and Technology	1	0	0	1
2.	BS	MA20301	Transforms and Boundary Value Problems	3	1	0	4
3.	PC	BT20301	Biochemistry	3	0	0	3
4.	PC	BT20302	Microbiology	3	0	0	3
5.	ES	BT20303	Fluid Mechanics for Biotechnologist	3	0	0	3
6.	PC	BT20304	Stoichiometry	3	0	0	3
7.	MC	MC20301	Value Education	2	0	0	0
PRACTICALS							
8.	PC	BT20305	Biochemistry laboratory	0	0	4	2
9.	PC	BT20306	Microbiology laboratory	0	0	4	2
10.	EE	EN20301	English Proficiency Course Laboratory	0	0	2	1
			TOTAL	**18**	**1**	**10**	**22**

SEMESTER IV

S. No.	CATEGORY	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY							
1.	BS	MA20403	Probability and Statistics	3	1	0	4
2.	BS	CH20401	Instrumental Methods of Analysis	3	0	0	3
3.	PC	BT20401	Bioprocess Principles	3	0	0	3
4.	ES	BT20402	Heat and Mass Transfer Operations	3	0	0	3
5.	PC	BT20403	Basic Industrial Biotechnology	3	0	0	3
6.	PC	BT20404	Cell Biology	3	0	0	3
PRACTICALS							
7.	BS	CH20402	Instrumental Analysis Laboratory	0	0	4	2
8.	PC	BT20405	Heat and Mass Transfer Laboratory	0	0	4	2
			TOTAL	**18**	**1**	**8**	**23**

GE20301 **தமிழரும் தொழில்நுட்பமும்** L T P C 1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடுவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் &சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை வடிவமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும் கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை

அலகு III உற்பத்தி தொழில் நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பு உருக்குதல், எஃகு - வரலாற்றுச் சின்னங்களாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் -எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம் 3

அணை - ஏரிகுளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு -அறிவுசார் சமூகம்

அலகு V *அறிவியல் தமிழ் மற்றும் கணித்தமிழ்* 3

அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் சொற்குவைத் திட்டம்

TOTAL PERIODS: 15

TEXT CUM REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை. (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A Joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by International institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subramanian, Dr.K.D.Thirunavukkarasu)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International institute of Tamil Studies)
9. Keeladi – 'Sangam City Civilzation on the vanks of river vaigai' (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by the author)
11. Porunai Civilization (Jointly Published by Department of Arcaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu).
12. Journey of Civilization Indus to vaigai (R.Balakrishnan) (Published by RMRL) – Reference Book

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

GE20301	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and goldCoins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project

TOTAL PERIODS: 15

TEXT CUM REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை. (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு).

5. Social Life of Tamils (Dr.K.K.Pillay) A Joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by International institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subramanian, Dr.K.D.Thirunavukkarasu)
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International institute of Tamil Studies)
9. Keeladi – 'Sangam City Civilzation on the vanks of river vaigai' (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by the author)
11. Porunai Civilization (Jointly Published by Department of Arcaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamilnadu).
12. Journey of Civilization Indus to vaigai (R.Balakrishnan) (Published by RMRL) – Reference Book

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

MA20301 **TRANSFORMS AND BOUNDARY VALUE PROBLEMS** **3 1 0 4**

(Common to Aero, Agri, Chemical, EEE, Civil, Food, IT, Mech, MCT, Pharma, Robotics, Safety & Fire, Bio-Tech)

OBJECTIVES

To enable the students to

- introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- formulate Partial Differential Equations and use Mathematical tools for the solution of PDE that model several physical processes
- develop the modeling of one dimensional equation of heat conduction, wave equation and two dimensional Laplace equation
- develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform does for continuous systems, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES **12**

Dirichlet's conditions; General Fourier series; Odd and even functions; Half range series; Complex form of Fourier Series; Parseval's identity; Harmonic Analysis.

UNIT II FOURIER TRANSFORMS **12**

Fourier integral theorem (without proof); Fourier transform pair; Convolution theorem; Parseval's identity; Sine and Cosine transforms - Properties; Transforms of elementary functions.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations; Lagrange's linear equation; Solutions of four standard types of first order partial differential equations; Linear partial differential equations of second order with constant coefficients.

UNIT IV FOURIER SERIES SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS **12**

Solutions of One-dimensional wave and heat equation; Steady state two-dimensional heat equation.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms - Elementary properties; Inverse Z-transform; Convolution theorem; Formation of difference equations; Solution of difference equations using Z-transform.

TOTAL PERIODS: 60

OUTCOMES

At the end of the course, the students will be able to

- derive Fourier series, their possible forms of representations of periodic functions
- identify and formulate a function in frequency domain whenever the function is defined in time domain
- formulate and solve partial differential equations that occur in many engineering applications
- model wave and heat equations, solve certain boundary value problems and use the solution methods in engineering applications.
- demonstrate the use of Z-transform to convert discrete functions into complex frequency domain representation

TEXT BOOKS

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi,(2011).

REFERENCE BOOKS

1. Narayanan S., Manickavasagam Pillai.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" ,Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.
2. Larry C. Andrews, Bhimsen K. Shivamoggi, "Integral Transforms for Engineers", SPIE Optical Engineering press, Washington USA (1999).
3. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2010).
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
5. Erwin Kreyszig., "Advanced Engineering Mathematics" 10th Edition, Wiley Publications.

CO/PO Mapping

Mapping of Course Outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3- Strong, 2-Medium, 1-Weak														
CO	Programmes Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-	1	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	-	-

BT20301 **BIOCHEMISTRY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the chemical basis of biology and the structure of carbohydrates and lipids
- comprehend the structure of amino acid, protein, enzyme and nucleic acid structure and their function
- educate various metabolic pathways of carbohydrates and their interconnection
- inculcate the metabolic pathways of lipids
- introduce them regulation and metabolism of amino acids and protein

UNIT I INTRODUCTION TO BIOMOLECULES - CARBOHYDRATES **9**

Basic principles of organic chemistry, role of carbon, types of functional groups, chemical, nature of water, pH and biological buffers, bio molecules structure and properties of carbohydrates (mono, di, oligo & polysaccharides) proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reactions of monosaccharides, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans, hyaluronic acid, chondroitin sulfate.

UNIT II STRUCTURE AND PROPERTIES OF OTHER BIOMOLECULES **9**

Structure and properties of important biomolecules; **Lipids**: Fatty acids, glycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids, cholesterol, steroids, prostaglandins. **Protein**: Amino acids, peptides, proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins and determining of primary structure. **Nucleic acids:** purines, pyrimidines, nucleoside, nucleotide, RNA, DNA-Watson-Crick structure of DNA, reactions, properties, measurement, nucleoprotein complexes.

UNIT III METABOLISM CONCEPTS AND CARBOHYDRATE METABOLISM **9**

Functions of proteins, enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt.

UNIT IV INTERMEDIARY METABOLISM AND REGULATION **9**

Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, bioenergetics - high energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

UNIT V PROTEIN TRANSPORT AND DEGRADATION **9**

Protein targeting, signal sequence, secretion; folding, chaperone and targeting of organelle proteins, protein degradation, receptor-mediated endocytosis, turnover.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the student will be able to

- ensure students have a strong foundation in the structure of biomolecules.
- correlate the lipids, proteins and nucleic acids with biotechnology applications.

- illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways.
- analyze the metabolic pathways of lipids in detail.
- compare various metabolic pathways of the major biomolecules and relevance to clinicai conditions.

TEXT BOOKS

1. Nelson DL, Lehninger AL, Cox MM, "Lehninger Principles of Biochemistry", 6th Edition, W.H.Freeman and Company, 2017
2. Satyanarayana U, Chakrapani U, "Biochemistry", 5th Edition, Books & Ailled (P), 2020.

REFERENCES

1. Berg JM, Tymoczko JL, Stryer L, "Biochemistry", 6th Edition, W.H. Freeman & Company, 2017
2. Rodwell VW, Bender D, Botham KM, "Harper's Illustrated Biochemistry", 31st Edition, McGraw-Hill, 2018.
3. Voet D, Voet JG, Pratt CW, "Voet's principles of biochemistry", 5th Edition, John Wiley & Sons Inc., 2018.
4. Horton HR, Moran LA, Scrimgeour KG, Perry MD, Rawn JD, "Principles of Biochemistry", 5th Edition, Pearson New International, 2014.

CO/PO MAPPING:

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	3	2	2	2	3	3	2	3
CO2	2	2	3	2	2	2	2	2	-	3	2	3	2	3
CO3	3	3	3	2	3	-	2	1	-	2	1	1	2	3
CO4	2	3	3	3	2	-	3	-	1	2	1	1	3	3
CO5	2	3	3	2	3	2	3	2	2	1	2	2	1	3

BT20302 **MICROBIOLOGY** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on fundamentals of microbiology
- understand the structural organization of microbes
- inculcate the role of nutritional requirements and growth characteristics of microbes
- educate the mechanism of microbial infection and their control
- comprehend the role of microbes in various industries and environment

UNIT I INTRODUCTION TO MICROBIOLOGY 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.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 9

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of the life history of actinomycetes, yeast, mycoplasma and bacteriophages.

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.

UNIT IV CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- remember the history, classification of microbes and the principle of microscopy and staining
- compare the structural organization and multiplication of microbes.
- identify nutritional requirements and growth characteristics of microbes.
- optimize different methods for control of microorganisms.
- summarize the various applications of microorganisms in industry and environment.

TEXT BOOKS

1. Pelczar MJ, Chan ECS, Krein NR, "Microbiology", Tata McGraw Hill Edition, New Delhi, India, 2009.
2. Prescott LM, Hardy MP, Klein JP, "Microbiology", 8th Edition, McGraw Hill, New York, 2006.

REFERENCES

1. Black JG, Black LJ, "Microbiology: principles and explorations", 10th Edition, John Wiley & Sons, 2018
2. Ananthanarayan CK, Panikars J, "Textbook of Microbiology", 7th Edition, Orient Longman Private Limited, 2005.
3. Alberts B, Heald R, Johnson A, Morgan D, Raff M, Roberts K, Walter P, "Molecular Biology of the Cell", 7th International Student Edition, W.W. Norton & Company, 2022.
4. Talaro KP, Chess B, "Foundations in Microbiology", 8th Edition, McGraw-Hill Education, 2011.

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	2	2	2	2	2	2	2	2	2
CO2	3	3	2	3	2	2	3	2	2	3	2	2	3	3
CO3	2	3	2	3	3	2	3	2	2	3	2	2	3	2
CO4	2	3	3	3	3	2	2	2	2	2	3	3	3	2
CO5	2	3	2	3	3	2	1	-	2	-	2	2	3	3

BT20303 FLUID MECHANICS FOR BIOTECHNOLOGIST 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge dynamics and properties of fluid flow.
- understand the engineering of fluid mechanics (flow measurements).
- inculcate dynamic characteristics of fluid flow through pipes and porous medium.
- study the information about mechanism of fluidized and packed beds.
- comprehend the methods for size reduction and energy requirements.

UNIT I INTRODUCTION 9

Properties of fluids- fluid statics, concept of shear stress, Newton's law of viscosity – Fluid behaviour under shear, Newtonian and non-Newtonian fluids, Types of flow – laminar, turbulent, steady, unsteady, non-uniform and uniform flows – compressible and incompressible fluids, Similitude -relationship between dimensional analysis and similitude- Applications in Bio-fluids.

UNIT II FLUID DYNAMICS 9

Continuity equation, Bernoulli's equation, boundary layer condition, form drag, skin drag, drag coefficient – laminar and turbulent flow through closed conduit velocity profiles, pipes, tubes, fittings, valves, friction factor for smooth and rough pipes, head losses due to friction in pipes and fittings, Applications.

UNIT III FLUID FLOW MEASURMENT AND PUMPING EQUIPMENTS 9

Orifice meter, Venturimeter, Pitot tube, Rotameter, weirs and notches, hot wire anemometer, displacement meter, current meter, magnetic flow meter, pressure measurement by manometers, U-tube, differential and inclined manometers. Pumps – types, selection and specifications, positive displacement pumps, reciprocating pump, rotary pumps, centrifugal pumps - characteristics curve of pumps – fans and compressors, Applications.

UNIT IV FLUIDIZATION AND PACKED BEDS 9

Mechanisms, types – fluidized beds, properties of fluidized beds, continuous fluidization and applications, packed beds – pressure drop, flooding and loading. Mixing & agitation.

UNIT V MECHANICAL OPERATIONS 9

Size reduction equipment – operations and their classification, Energy and power requirements, Laws of crushing, open and closed-circuit operations - techniques of size analysis – different methods for storage of solids, conveyors and elevators.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- evaluate stress–strain relationship in fluids and analyse fluid flow problems.
- illustrate Bernoulli principle and measure pressure drop in flow systems.
- describe the function and performance of flow metering devices.
- determine minimum fluidization velocity in fluidized bed.

- summarize the characteristics of particulate solids, principles of size reduction and screening, crushing and grinding equipment.

TEXT BOOKS

1. McCabe, WL, Smith JC, Harriot P, "Unit Operations of Chemical Engineering", 7th Edition, McGraw Hill, 2014
2. Geankoplis CJ, "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India, 2002.

REFERENCES

1. Coulson JM, Richardson JF, Sinnott RK, "Chemical Engineering. Vol I & II", 6th Edition, Butterworth-Heinemann Ltd, 1998.
2. Bansal RK, "Fluid Mechanics and Hydraulic Machines", 5th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2008.
3. Foust AS, Wenzel LA, Clump CW, Naus L, Anderson LB, "Principles of Unit Operations", 2nd edition, John Wiley & Sons, 2008.
4. Wen-Ching Yang, "Handbook of Fluidization and Fluid-Particle Systems", Marcel Dekker Inc, 2003.

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	_	3	3	2	1	_	_	_	_	_	_	3	3	1
CO2	2	2	_	3	_	_	1	1	2	1	2	3	3	1
CO3	2	2	3	1	2	2	_	_	_	_	_	2	1	3
CO4	1	3	3	2	1	_	1	2	_	_	_	3	3	2
CO5	1	3	_	_	1	_	_	_	1	1	1	3	3	2

BT20304	STOICHIOMETRY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

- understand the importance of various systems of units and dimensions pertaining to unit operations and unit processes.
- information about the ideal and actual gas equations
- importance of material balance calculation for various unit operations.
- perform energy balance calculations for unit process.
- develop skills of the students in the area of Chemical Engineering with emphasis in calculations for various processes and operations.

UNIT I BASIC CHEMICAL CALCULATIONS 9

Dimensions – Systems of units - Engineering FPS, Engineering MKS & SI systems, Basic and derived units – Conversion from one system to other systems. Moles, density and composition – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density.

UNIT II IDEAL AND ACTUAL GAS EQUATIONS 9

Ideal and actual gas equations, Vander Walls, compressibility factor equations, application to pure gas & gas mixtures – partial pressures, partial volumes – Air-water vapour systems, Humidity, Molar Humidity, Relative Humidity, % Saturation, humid Volume – Humidity chart – wet, dry bulb, dew point temperatures, pH of solutions, Vapour pressure.

UNIT III MATERIAL BALANCE 9

Material balance concept – overall & component – material balance applications for the evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, crystallization, drying, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration.

UNIT IV ENERGY BALANCE 9

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess

UNIT V THE CHEMICAL REACTION EQUATION 9

Chemical Reaction-Limiting, excess component, Fractional conversion, Percent conversion, Fractional yield in multiple reactions. Simple problems, material balances involving combustion Reactions.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics.
- apply their knowledge in the field of biochemical engineering from the principles of thermodynamics

- solve problems related to material balance concepts & design reactors for biochemical processes
- solve problems related to energy balance concepts & perform calculations pertaining to processes and operations.
- gain extensive knowledge on Conversion and Percent Yield for single and multiple chemical reactions

TEXT BOOKS

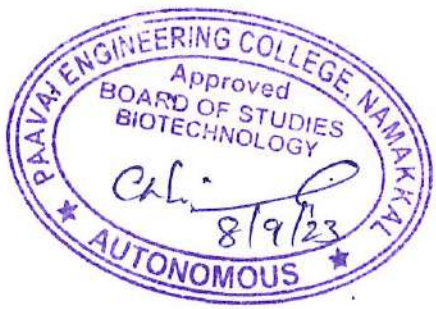
1. Bhatt BI and Thakore SB, "Stoichiometry", 5th edition, Tata McGraw Hill, 2017.
2. Kavhane KA, "Introduction to Process calculations", 1st Edition, Nirali Publishers, 2016.

REFERENCES

1. McCabe WL, Smiith JC and Harriot P, "Unit operations of chemical Engineering", 7th Edition, McGraw Hill, 2017.
2. Pushpavanam S, "Introduction to Chemical Engineering", 1st Edition, PHI Learning Pvt. Ltd., 2012
3. Narayanan KV, Lakshmikutty B, Stoichiometry and Process Calculations, 2nd edition, PHI Learning Pvt. Ltd., 2016
4. Himmelblau DM, Riggs JB, "Basic Principles & Calculations in Chemical Engineering" 9th edition, Pearson, 2022.

CO/PO MAPPING:

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO3	3	2	1	2	1	1	-	-	-	-	-	-	2	1
CO4	3	2	1	1	1	1	-	-	-	-	-	-	2	2
CO5	3	2	1	1	1	1	-	-	-	-	-	-	2	2



MC20301 VALUE EDUCATION 2 0 0 0

COURSE OBJECTIVES

To enable the students to

- develop the individual multi-dimensionally in physical, intellectual, emotional and spiritual dimensions.
- facilitate individuals think about and reflect on different values.
- understand their responsibility in making choices and the practical implications of expressing them.
- instigate to choose their personal, social, moral and spiritual values.
- design and chisel the overall personality of an individual.

UNIT I PERSONAL VALUES 6

Value Education – Definition, Types of values; Human values - Respect, Acceptance, Consideration, Appreciation, Listening, Openness, Affection, Patience, Honesty, Forgiveness, Sacrifice, Authenticity, Self Control, Altruism, Tolerance and Understanding, Wisdom, Decision making, Self –actualization, Character formation towards positive Personality, Contentment; Religious Values -Humility, Sympathy and Compassion, Gratitude. Peace, Justice, Freedom, Equality.

UNIT II COMMUNAL VALUES 6

Social Values - Pity and probity - Self control - Respect to Age, Experience, Maturity, Family members, Neighborhood- Universal Brotherhood - Flexibility -Peer pressure - Sensitization towards Gender Equality, Physically challenged, Intellectually challenged - Reliability - Unity - Modern Challenges of Adolescent Emotions and behavior - Comparison and Competition- Positive and Negative thoughts- Arrogance, Anger and Selfishness.

UNIT III ENGINEERING ETHICS 6

Professional Values -.Knowledge thirst - Sincerity in Profession- Regularity, Responsibility, Punctuality and Faith - Perseverance - Courage - Competence - Co-operation- Curbing unethical practices - Integrity, Social Consciousness and Responsibility.Global Values - Computer Ethics – Moral Leadership - Code of Conduct - Corporate Social Responsibility.

UNIT IV SPIRITUAL VALUES 6

Developing Spirituality - Thinking process, Moralization of Desires - Health benefits- Physical exercises, Mental peace; Meditation - Objectives, Types, Effects on body, mind and soul; Yoga - Objectives, Types, Asanas;. Family values -family's structure, function, roles, beliefs, attitudes and ideals, Family Work Ethics, Family Time, Family Traditions.

UNIT V HUMAN RIGHTS 6

Classification of Human Rights - Right to Life, Liberty and Dignity- Right to Equality - Right against Exploitation - Cultural and Educational Rights- Physical assault and Sexual harassment - Domestic violence.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of this course, the students will be able to

- cultivate the values needed for peaceful living in the existing society.
- comprehend humanistic values to develop peace in the world.
- foster ethics in profession and usage of technology.
- orient with the importance of value education towards personal, group and spiritual attributes.
- nurture physical, mental, spiritual growth to face the competitive world.

TEXT BOOKS

1. Sharma, S.P. Moral and Value Education; Principles and Practices, Kanishka publishers, 2013.

REFERENCES

1. Little, William, An introduction of Ethics. Allied publisher, Indian Reprint 1955.

2. "Values (Collection of Essays)". Sri Ramakrishna Math. Chennai. 1996.

CO/PO Mapping

	Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO2	-	-	-	2	-	2	-	1	3	2	1	3	-	2
CO3	-	-	3	2	2	3	2	3	3	1	3	3	2	3
CO4	-	-	3	1	-	2	-	-	1	-	-	3	2	-
CO5	-	-	-	-	-	1	-	-	-	-	-	3	-	-

BT20305 **BIOCHEMISTRY LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- learn and understand the fundamental approaches for experimentally investigating biochemical problems.
- able to extract living cell samples from plants and animals for genetic research.
- carryout experimental research on bimolecular separation
- understand the biochemical techniques and its applications

LIST OF EXPERIMENTS

1. General guidelines for working in biochemistry laboratory (theory)
2. Units of volume, weight, density and concentration measurement and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices
3. Accuracy, precision, sensitivity and specificity (Theory)
4. Preparation of buffer- titration of weak acid and a weak base
5. Qualitative tests for carbohydrates- distinguishing reducing from non-reducing sugars and keto from aldo sugars
6. Qualitative method for amino acid estimation using ninhydrin- distinguishing amino from imino acid
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of chlorophyll and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- adapt methods for biochemical analysis
- carry out experiments in biomolecular separations
- learn and understand the principles behind the qualitative and quantitative estimation of biomolecules.
- understand the applicability of biochemical methods to realistic solution

CO/PO MAPPING:

Mapping of Course outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	3	1	3	2	3	1	2	2	3	2
CO2	2	1	3	-	2	1	-	1	2	-	-	3	3	3
CO3	2	2	2	1	2	1	-	1	2	-	-	3	3	3
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	2

BT20306 **MICROBIOLOGY LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- demonstrate various techniques to learn the morphology, identification and propagation of microbes
- familiarize with various cells staining techniques and handling microorganisms
- describe the characteristics of pathogens and spoilage microorganisms
- know the basic practices in laboratory

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Identification of microorganisms by Simple staining technique.
3. Identification of microorganisms by Gram's staining technique.
4. Observation of microorganisms by wet mount preparation and hanging drop technique.
5. Culture Media-Types and Use; Preparation of Nutrient broth and agar
6. Quantification of microorganisms by serial dilution method.
7. Cultivation and enumeration of microorganisms using spread plate method.
8. Isolation of microorganisms by pour plate method.
9. Isolation of microorganisms by streak plate method.
10. Cultivation and enumeration of microorganisms from a given sample (air/soil/water).
11. Biochemical characteristics of microorganisms using IMVIC test.
12. Antibiotic sensitivity test for microorganisms

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand the advanced technical information pertaining to laboratory bio-safety and preventive measures from pathogenic microorganism
- know the various aseptic techniques and sterilization methods
- develop the minimum skills to work on several important techniques for the study of microorganisms in the laboratory
- learn the various techniques of culturing of microorganisms and media preparation

CO/PO MAPPING:

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	2	3	1	1	3	3	2	3	3	3
CO2	1	3	2	3	1	1	2	2	2	3	3	3	3	3
CO3	2	3	3	3	3	2	1	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	2	3	3	3	3	3	3

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

EN20301 ENGLISH PROFICIENCY COURSE LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- familiarize with the reading skills such as skimming and scanning.
- practise writing tasks to the level expected
- develop listening strategies such as listening for key words, making inferences and identifying main ideas.
- speak well without inhibition and to assist the students in improving their vocabulary, pronunciation and comprehension of grammar.
- enrich their LSRW skills so as to crack on-line proficiency tests and to bring their career aspirations true.

EXERCISES FOR PRACTICE

1. Listening Exercises from TOEFL
    a. Conversations, Lectures
2. Listening Exercises from IELTS
    a. Places and directions
3. Reading Exercises from BEC Vantage & BEC Higher
    a. Error identification
    b. Gap filling
4. Writing Exercises from PTE
    a. Summarize written text
5. Writing Exercises from IELTS
    a. Describing maps
    b. Describing diagrams
6. Speaking IELTS format
    a. Talking about familiar topics
    b. Giving a talk
    c. Discussion on a Topic

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, the students will be able to

- skim, scan and infer the given texts and attend the tasks successfully.
- write coherently using appropriate vocabulary and grammar.
- listen to speeches and conversations and answer the questions.
- communicate fluently on any given topics
- appear with confidence for on-line tests.

REFERENCES

1. Cambridge University Press India Pvt. Ltd, New Delhi.2016.
2. PTE Academic Test builder. Macmillan Education. London. 2012.
3. Cambridge IELTS 12 Academic Student's Book with Answers: Authentic Examination Papers (IELTS... by Cambridge University Press . New Delhi.2016
4. TOEFL iBT Prep Plus 2018-2019 4 Practice Tests) Kaplan Publishing. Newyork.2017.

WEB LINKS

1. https://magoosh.com/toefl/2018/best-toefl-books/
2. https://ptetutorials.com/
3. http://ieltsliz.com/recent-ielts-questions-and-topics/

CO/PO Mapping

	Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak													
COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	2	3	-	-	-	3	2	-	-	-	2
CO2	-	-	2	2	-	-	1	1	3	2	-	2	-	2
CO3	-	-	-	-	-	3	1	2	3	2	2	3	2	-
CO4	-	-	-	-	-	2	2	3	3	2	2	-	2	-
CO5	-	-	2	-	-	1	2	-	3	3	-	1	2	3

MA20403 **PROBABILITY AND STATISTICS** **3 1 0 4**

(Common to Agri, BME, Bio-Tech, Cyber, CSE, CSE(IOT), CSE(AI&ML), IT, Food, Pharma)

OBJECTIVES

To enable the students to

- analyse the concept of Random variables and probability distribution in designing processes.
- know and differentiate the discrete and continuous two dimensional random variables.
- determine the concepts of hypotheses testing, its need and applications.
- equip with statistical techniques for designing experiments, analyzing, interpreting and presenting research data.
- emphasize the aspects of statistical tools in engineering problems.

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of random variables.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Linear regression - Transformation of random variables –Applications of Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 12

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

UNIT IV DESIGN OF EXPERIMENTS 12

ANOVA - One way and Two way classifications - Completely randomized design - Randomized block design - Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements (X and R charts) - Control charts for attributes (P, C and NP charts) - Tolerance limits - Acceptance sampling.

TOTAL PERIODS: 60

OUTCOMES

At the end of the course, the students will be able to

- demonstrate the fundamental concepts of probability and probability distributions of random variables in designing process
- identify the differences in two dimensional random variables
- implement the statistical techniques to hypotheses testing of engineering and management problems
- be aware of the principles to be adopted for designing the experiments.
- compare statistical date using control chart in quality control

TEXT BOOKS

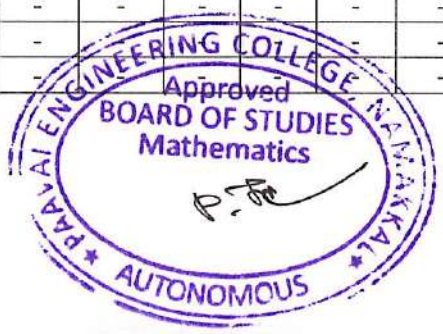
1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., Miller and Freund's Probability and Statistics for Engineers", PearsonEducation, Asia, 7th Edition, 2007.
3. Papoulis. A andUnnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes"McGraw Hill Education India,4th Edition, New Delhi, 2010.

REFERENCE BOOKS

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum"s Outline of Theory and Problems ofProbability and Statistics", Tata McGraw Hill Edition, 2004.

CO/PO Mapping:

Mapping of Course Outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3- Strong, 2-Medium, 1-Weak														
CO	Programmes Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	2	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	3	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	3	-	-



CH20401 **INSTRUMENTAL METHODS OF ANALYSIS** 3 0 0 3

(Common to Biotechnology)

COURSE OBJECTIVES

To enable the students to

- understand the basics of spectrometric techniques.
- establish the knowledge of principle and working of absorption, fluorescence and other molecular spectroscopic instruments.
- have a fundamental knowledge about the NMR and Mass spectroscopy.
- predict the separation and purification of biomolecules by chromatography.
- learn the electro analysis and surface microscopy.

UNIT I INTRODUCTION TOSPECTROMETRY 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 – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – NMR- Spectrometers – applications - Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography - size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC-Capillary electrophoresis – Applications.

UNIT V ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of the course, the students will be able to

- acquire a fundamental knowledge about the light spectrum and basics of measurement.
- have a knowledge about the working principle of optical methods and working principle of spectroscopic techniques.
- comprise a developed knowledge about the working principle of resonance and mass spectrometry.
- acquire knowledge on different types of chromatographic methods for separation of biological products.
- acquire knowledge on different types of electro analytical methods and electron microscopes.

TEXT BOOKS

1. Willard, Merrit H., "Instrumental Methods of Analysis", Prentice hall of India, 7th Edition,2012.
2. Skoog, "Principles of Instrumental Analysis" Brooks Cole, 6th Edition, 2007.

REFERENCES

1. Wilson K., Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 7th Edition, 2010.
2. Robert D.B., "Introduction to Instrumental Analysis", McGraw Hill, 1st Edition, 1986.
3. Pungor E., Horvai E.,"A Practical Guide to Instrumental Analysis",CRC Press, 1st Edition,19.
4. Sharma.B.K."Instrument methods of chemical analysis analytical chemistry, Krishna prakashan media(P)Ltd,2014.
5. Gary D.C., O'Reilly J.E., "Instrumental Analysis", Pearson Education, 6th revised Edition, 1986

CO - PO Mapping:

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	1	3	2	1	1	-	-	1	2	3	1
CO2	3	2	-	1	3	1	1	-	-	1	2	3	3	2
CO3	3	3	-	2	3	1	3	1	-	1	2	3	2	3
CO4	3	2	-	1	3	2	2	2	-	1	2	3	2	2
CO5	3	2	-	1	3	1	3	1	-	1	2	3	3	3

BT20401	BIOPROCESS PRINCIPLES	3	0	0	3

COURSE OBJECTIVES

To enable the students to

- make aware of the development of fermentation processes.
- provide the information about importance of medium formulations and optimization.
- impart knowledge on design and operation of fermentation processes with all its prerequisites.
- endow with the basics of microbial kinetics, metabolic stoichiometry and energetics.
- provide the information about kinetics of microbial growth.

UNIT I OVERVIEW OF FERMENTATION PROCESSES 9

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION 9

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods.

UNIT III STERILIZATION KINETICS 9

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of batch and continuous sterilization equipment.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 9

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation – Direct and Indirect methods.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the student will be able to

- identify suitable process instrumentation for monitoring and control of fermentor
- formulate the fermentation medium to facilitate improved product production
- select and apply the sterilization techniques in bioprocessing
- interpret the metabolic stoichiometry in microbial processes
- analyze the kinetics of microorganisms during fermentation processes and to develop strategies to solve the issues in bioprocessing

TEXT BOOKS

1. Shuler ML, Kargi F, De Lisa M, "Bioprocess Engineering: Basic Concepts", 3rd Edition, Prentice Hall, 2017.
2. Pauline D, "Bioprocess Engineering Principles", 2nd Edition, Elsevier, 2012.

REFERENCES

1. Stanbury PF, Whitaker A, Hall SJ, "Principles of fermentation technology", 2nd Edition, Elsevier, 2013.
2. Villadsen J, Nielsen J, Liden G, "Bioreaction Engineering Principles", 3rd Edition, Springer, 2011.
3. Nelson DL, Cox MM, "Lehninger Principles of Biochemistry", 8th edition, W H Freeman & Co, 2021.
4. Mathews KC, Appling DR, "Biochemistry", 4th Edition, Pearson Education, 2012

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1	2	-	2	1	3	2	3	2
CO2	3	3	3	2	2	3	3	-	-	-	2	2	3	3
CO3	3	3	3	2	2	-	-	-	-	-	2	3	3	1
CO4	3	3	3	2	2	3	3	2	2	2	-	1	3	1
CO5	3	3	3	2	2	3	3	1	2	2	-	1	3	-

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

BT20402 **HEAT AND MASS TRANSFER OPERATIONS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart the basic concepts of mass transfer and diffusion of fluids along with the various modes heat transfer process.
- understand the separation process and its types.
- study various types of dryers and crystallization.
- evaluate the basic concept about the various methods of conductive and convective heat transfer.
- elucidate the various types of heat exchanger and its evaporators.

UNIT I PRINCIPLES OF MASS TRANSFER 9

Introduction to Mass transfer and diffusion, Ficks law for molecular diffusion, Molecular diffusion in gases, Molecular diffusion in liquid, Molecular diffusion in solids, Molecular diffusion in biological solutions and gels. Introduction to convective mass transfer, Convective mass transfer coefficients. The analogy between Mass, Heat and momentum transfer.

UNIT II BASIC SEPARATION PROCESSES – 1 9

Introduction to separation processes, Distillation, Types of distillation – Simple, Steam, Vacuum, Continuous distillation, absorption-packed and plate columns, Adsorption-chemisorption, physical adsorption, isotherms, membrane separation process – Electrodialysis

UNIT III BASIC SEPARATION PROCESSES -2 9

Drying, -Tray dryer, Vacuum dryers, rotary dryers, drum and spray dryers. Equilibrium moisture content of materials. Bound and unbound moisture. Free and equilibrium moisture, Rate of Drying curves, Freeze drying and Sterilization of Biological materials, Crystallization - theory, Equipment's for crystallization, Tank, DTB Crystallizer, circulating –magma vacuum crystallizer, Swenson walker crystallizer.

UNIT IV PRINCIPLES OF HEAT TRANSFER 9

Introduction to various modes of heat transfer, Conduction- Fourier's law of heat conduction, thermal conductivity, Conduction through liquids. Convection, individual and overall heat transfer coefficient, LMTD, radiation.

UNIT V HEAT TRANSFER OPERATIONS 9

Evaporators-natural circulation, forced-circulation, and agitated-film evaporators. Methods of operation of evaporators-single-effect and multiple-effect evaporators, Evaporation of Biological materials- fruit juices, sugar solution and paper-pulp waste liquors. Heat Exchangers - Flow patterns in Heat Exchangers, Types - Double pipe exchanger, shell-and-tube exchanger, condensers, kettle-type reboilers.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- elucidate the convective mass transfer
- analyze the principles and operation of various separation processes

- illustrate the mechanism of crystallization and drying
- learn about the basis of heat transfer
- evaluate the operation of evaporators and design of evaporators

TEXT BOOKS

1. Treybal RE, "Mass Transfer Operations", 3rd edition, Mcgraw Hill, 2017.
2. Kreith F, Manglik RM, "Principles of Heat Transfer", 8th edition, CL Engineering, 2017.

REFERENCES

1. Bergman TL, Lavine AS, Incropera FP, DeWitt DP, "Fundamentals of Heat and Mass Transfer", 8th edition, John Wiley, 2018.
2. Anantharaman N, Meera Sheriffa Begum KM, "Mass Transfer Theory and Practice", 1st Edition, PHI, 2011.
3. Patil KD, "Principles of Mass Transfer Operations", 8th edition, Nirali Prakashan, 2019.
4. Rajput RK, "A text Book of Heat & Mass Transfer SI Units", S Chand Publisher, 2018.

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs		Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	–	–	–	–	3	1	–	1	3	3
CO2	3	–	3	2	2	–	–	–	3	2	–	2	3	3
CO3	1	1	2	2	2	–	2	1	2	2	–	1	1	2
CO4	2	2	2	2	2	–	–	2	2	2	2	2	1	2
CO5	2	1	2	1	1	–	–	2	2	2	2	2	2	3

BT20403 BASIC INDUSTRIAL BIOTECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the development of industrial bioprocess and its major components.
- analyze the significance of steps involved in the production of primary metabolites.
- explain the need and production of secondary metabolites.
- summarize the sequential steps involved in production of enzymes and other bio products.
- comprehend the production of modern biotechnological products.

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, and products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES 9

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT III PRODUCTION OF SECONDARY METABOLITES 9

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 9

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers, Biodiesel. Cheese, Beer, SCP & Mushroom culture, Bioremediation

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 9

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Production of Bioprocess strategies in Plant Cell and Animal Cell culture.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- outline the development of industrial bioprocess and its major components.
- analyze the significance of steps involved in the production of primary metabolites.
- explain the need and production of secondary metabolites.
- summarize the sequential steps involved in production of enzymes and other bioproducts.
- comprehend the production of modern biotechnological products.

TEXT BOOKS

1. Satyanarayana U, "Biotechnology", 6th Edition, Books and Allied (p) Limited, 2017.
2. Dubey RC, "A Textbook of Biotechnology" 5th Edition, S. Chand & Company Ltd., 2022.

REFERENCES

1. Casida LE, "Industrial Microbiology", 2nd Edition, New Age International (P) Ltd, 2019.

2. Presscott SC, Dunn CG, "Industrial Microbiology", 1st Edition, Agrobios (India), 2009.
3. Cruger W, Crueger A, "Biotechnology: A Textbook of Industrial Microbiology", 3rd Edition, Medtech Publishers, 2000.
4. Stanbury PF, Whitaker A, Hall SJ, "Principles of fermentation technology", 2nd Edition, Elsevier, 2013 Oct 22.

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	-	-	3	2	-	-	2	-	3	-
CO2	2	-	3	-	3	-	2	3	-	-	3	-	2	2
CO3	2	-	3	-	3	-	2	2	-	-	2	-	3	2
CO4	2	-	3	-	2	-	2	-	-	-	2	1	2	-
CO5	2	-	3	-	3	-	3	2	-	-	2	2	2	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

BT20404 **CELL BIOLOGY** 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the cell, cytoskeleton architecture and cell junctions
- inculcate the mechanism of cell proliferation, control and cancer.
- understand the basis of molecular transport across the membranes.
- comprehend various signaling pathways and their functions.
- educate various techniques to study cells.

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cytoskeletal proteins. Extra cellular matrix, cell-cell junctions.

UNIT II CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS 9

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications

UNIT III TRANSPORT ACROSS CELL MEMBRANE 9

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ /Ca+2Tpumps, uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists

UNIT IV SIGNAL TRANSDUCTION 9

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V TECHNIQUES USED TO STUDY CELLS 9

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immunostaining.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, the students will be able to

- differentiate microbial, plant and animal cell and summarize the role of organelles and its movement.
- analyze and relate cell proliferation and cancer
- summarize the transport phenomena across the plasma membrane.
- evaluate various signaling pathways and its malfunctioning.
- able to apply various techniques to study cell.

TEXT BOOKS

1. Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Martin KC, Yaffe M, Amon A, "Molecular Cell Biology", 9th Edition, W H.Freeman, 2021.
2. Cooper G, Adams K, "The Cell: A Molecular Approach", 9th Edition, Oxford University Press, 2022.

REFERENCES

1. Hardin J, Lodolce J, "Becker's World of the Cell", 10th Edition, Pearson, 2021.
2. Simon E, Dickey J, Jane, "Campbell Essential Biology", 6th Edition, Pearson, 2019.
3. Alberts B, Hopkin K, Johnson A, Morgan D, Roberts K, Walterp, Heald R, "Essential Cell Biology", 6th Edition, W. W. Norton & Company, 2023.
4. Pollard TD, Earnshaw WC, Lippincott-Schwartz J, Johnson G, "Cell Biology", 4th Edition, Elsevier, 2022

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	3	3	2	2	-	3	-	-	1	1	1
CO2	2	2	2	2	3	-	1	1	3	-	2	3	3	2
CO3	2	3	3	2	1	-	2	-	2	-	1	1	1	2
CO4	2	1	3	2	3	1	-	1	-	-	-	3	1	2
CO5	3	2	2	3	1	-	-	-	2	2	2	1	1	2

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BIOTECHNOLOGY
8/9/23
AUTONOMOUS

CH20402 **INSTRUMENTAL ANALYSIS LABORATORY** 0 0 4 2

(Common to Biotechnology)

COURSE OBJECTIVES

To enable the students to

- learn the Precision and validity in an experiment using absorption spectroscopy.
- have a practical hands on experience on Absoprtion Spectroscopic method.
- validate Lambert-Beer's law.
- validate and analysis using spectrometric and microscopic techniques.

LIST OF EXPERIMENTS (Any Eight Experiments)

1. Precision and validity using absorption spectroscopy.
2. Validating Lamberts-Beers law using KMnO4 by colorimetry method.
3. Chromatography analysis using TLC.
4. Chromatography analysis using column chromatography.
5. Estimation of BOD.
6. Estimation of SO4- by nephelometry.
7. Finding the molar absorbtivity and stoichiometry of Fe (1,10 phenanthroline) using absorption spectrometry.
8. Finding the pKa value of 4-nitrophenol using UV-Visible absorption spectroscopy.
9. UV spectra of nucleic acids.
10. Limits of detection using aluminium alizarin complex.

TOTAL PERIODS : 60

COURSE OUT COMES

At the end of the course, the students will be able to

- understand the use of instrumental methods (spectroscopy) in biological sample analysis.
- acquire knowledge about the chromatographic method principle and resolving a compound using it.
- calculate the molecular weight of a given polymer.
- have the ability to trouble shoot problems in the experiment.

CO/PO Mapping:

(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
		Programmes Outcomes (POs)												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	CO 1	3	1	1	1	3	-	-	1	-	-	-	2	3
CO2	CO 2	3	2	1	1	3	-	-	-	-	-	-	1	3
CO3	CO 3	3	3	2	2	3	-	-	1	-	-	-	2	3
CO4	CO 4	3	2	2	1	3	-	-	2	-	-	-	2	3

BT20405 **HEAT AND MASS TRANSFER LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- study the basic phenomena of heat and mass transfer to develop methodologies for solving problems regarding heat and mass transfer operations
- understand the information, performance and design of heat exchangers
- develop process with better heat efficiency and economics
- provide a detailed experimental analysis

LIST OF EXPERIMENTS

1. Natural convection
2. Thermal Conductivity -Lagged Pipe
3. Thermal Conductivity -metal rod
4. Stefan Boltzmann constant for radiation heat
5. Forced convection
6. Double pipe heat exchanger -cocurrent flow
7. Double pipe heat exchanger -counter current flow
8. Separation of binary mixture using Steam distillation
9. Drying characteristics of Rotary dryer
10. Separation of binary mixture using Simple distillation

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, the students will be able to

- understand the basic laws of heat transfer and account for the consequence of heat transfer in thermal analyses of engineering systems
- understand the importance of fluid flow in industrial application
- describe the use of flow measuring devices and demonstrate the loss of energy due to friction in pipes
- calculate the loss of energy due to fittings in pipe flow systems

CO/PO MAPPING :

Mapping of Course outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programmes Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	3	3	-	-	-	-	-	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO4	2	-	-	-	-	3	3	2	-	-	-	-	2	2