B.Tech. BIOINFORMATICS

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FOREWORD

The discipline of Bioinformatics deals with the application of information technology to the management of bewildering biological data. It deals often with less about developing elegant algorithms than it is about answering practical questions. Computational biologists and Bioinformaticians are the tool-builders, and hence it's critical for them to understand biological problems as well as soft skills in order to produce useful tools. This interdisciplinary field of Bioinformatics is rapidly evolving in the last three decades. Storage of biological data in public databases has become increasingly common and these databases incessantly have grown exponentially.

The R22 curriculum in B. Tech Bioinformatics is designed to orient students in their profession such as self-employment and higher education. The four year B.Tech in Bioinformatics course depicts the fundamental concepts and methods in Information Technology and Bioinformatics. Data intensive and software based large-scale biological problems are addressed from a computational point of view. Moreover, it also provides a fast-paced introduction to the programming languages such as C language, JAVA and PYTHON, DBMS and R-programming. All key areas of bioinformatics are covered including biological databases, sequence alignment, gene and promoter prediction, molecular phylogenetics, structural bioinformatics, NGS, metagenomics, genomics & proteomics, machine learning, immunoinformatics and systems biology. Technical details of computational algorithms and graphical illustrations are provided in the curriculum. All key topics in bioinformatics encompassed in the curriculum make this program an ideal for all life science students and researchers who wish to develop and expand their knowledge in bioinformatics.

In addition to core courses in bioinformatics, students are having option to select electives out of a pool of professional electives in different areas of bioinformatics to acquaint technical skills. Furthermore, there is one semester long internship in 4(2) semester that provides industrial/research exposure to students. R-22 curriculum also allows students to get exposed to project-based learning from 3(1) semester onwards so as to inculcate in them the real explorative experience.

R22 curriculum comprises of:

Computer based core courses	Option to select NPTEL / SWAYAM courses for Add-on certificate/Honors
Bioinformatics core courses	Honors course
Open electives and Professional electives	Semester-long internship
Industry-Interface course	Research Projects

R-22 curriculum in B. Tech Bioinformatics is authenticated by the Industry Experts, Scientists from National Institutes and Reputed Academic Institutions

Prof. S. Krupanidhi
Dean, School of Biotechnology
and Pharmaceutical Sciences

Prof. T.C. Venkateswarulu
HoD, Biotechnology
Chairman - BOS

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

VISION

To evolve into a Centre of Excellence in Science & Technology through creative and innovative practices in teaching - learning, towards promoting academic achievement and research excellence to produce internationally accepted, competitive and world class professionals who are psychologically strong & emotionally balanced, imbued with social consciousness & ethical values.

MISSION

To provide high quality academic programmes, training activities, research facilities and opportunities supported by continuous industry – institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among students and contribute to the economic and technological development of the region, state and nation.

Department of BIOINFORMATICS

VISION of the department

To pursue academic and research excellence and promote interdisciplinary interest among biotechnology graduates through innovative teaching practices and industry interactions besides inculcating ethical values to shape them into socially responsible individuals.

MISSION of the department

To impart current developments to young biotechnologists through value based education and explore opportunities for supporting research and technology transfer with a broad thrust on areas relating to agriculture, pharmacy, human health and environment and ultimately to serve the community and nation at large.

B.Tech in Bioinformatics

Program Educational Objectives (PEOs)

PEO1: Identify, analyze and solve the biological issues using Bioinformatics approaches.

PEO2: To understand life and its processes at various levels of Biocomplexity using sequence-based and structure- based Bioinformatics approaches in the context of genomics, proteomics, and metabolomics.

PEO3: Enhance the knowledge base and skills for professional advancements.

PEO4: Communicate and draft effectively and demonstrate entrepreneurial and leadership skills

Program Specific Outcomes (PSOs)

PSO1: Developing the applications to solve biological problems by utlizing the Bioinformatics algorithms and programming languages.

PSO2: To serve as a facilitator and provide domain expertise for the use of databases and software packages for analysis and interpretation of biological data as required by researchers in the area of Biotechnology and Life Sciences.

Program Outcomes (POs)

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **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.

PO4: **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.

PO5: **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.

PO6: **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.

PO7: **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.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **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.

PO11: **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.

PO12: **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.

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

I Year I Semester

Course Code	Course Title	L	T	P	C	Course category
22MT101	Elementary Mathematics	3	2	0	4	Basic Sciences
22PY101	Applied Physics	2	2	0	3	Basic Sciences
22EE101	Basics of Electrical and Electronics Engineering	2	0	2	3	Basic Engineering
22BT103	IT Workshop and Bioproducts	1	0	4	3	Basic Engineering
22TP103	Programming in C	2	0	4	4	Basic Engineering
22EN102	English Proficiency and Communication Skills	0	0	2	1	Humanities
22SA101	Physical Fitness, Sports and Games – I	0	0	3	1	Binary grade
22TP101	Constitution of India	0	2	0	1	Binary grade
Total		**10**	**6**	**15**	**20**	
		31 Hrs				

I Year II Semester

Course Code	Course Title	L	T	P	C	Course category
22MT110	Matrices and Differential Equations	3	2	0	4	Basic Sciences
22CT104	Organic Chemistry	2	0	2	3	Basic science
22TP104	Basic Coding Competency	0	1	3	2	Basic Engineering
22ME101	Engineering Graphics	2	0	2	3	Basic Engineering
22EN104	Technical English Communication	2	0	2	3	Humanities
22BT101	Cell and Molecular Biology	3	0	2	4	Professional core
22SA103	Physical Fitness, Sports and Games – II	0	0	3	1	Binary grade
22SA102	Orientation Session	0	0	6	3	Binary grade
Total		**12**	**3**	**20**	**23**	
		35 Hrs				

Department Subject is extension of Basic sciences

COURSE STRUCTURE - R22

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

II Year I Semester

Course Code	Course Title	L	T	P	C	Course category
22ST201	Biostatistics and Design of Experiments	3	2	0	4	Basic Sciences
22TP201	Data Structures	2	2	2	4	Basic Engineering
22BT201	Biochemistry and Enzymology	3	0	2	4	Professional core
22BT203	Microbiology and Fermentation Technology	3	0	2	4	Professional core
22BI201	Algorithms in Bioinformatics	2	0	2	3	Professional core
22BI202	Biological Databases	3	0	2	4	Professional core
22SA201	Life Skills - I	0	0	2	1	Binary grade
Total		**16**	**4**	**12**	**24**	
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication.	0	0	0	1	Floating credits Binary grade
Total		**16**	**4**	**12**	**25**	
		32 Hrs				

II Year II Semester

Course Code	Course Title	L	T	P	C	Course category
22TP203	Advanced Coding Competency	0	0	2	1	Basic Engineering
22TP204	Professional Communication Laboratory	0	0	2	1	Humanities
22BI203	Python Programming for Biotechnologists	3	0	2	4	Professional core
22BI204	Structural Bioinformatics and Instrumental Techniques	2	0	2	3	Professional core
22CT201	Environmental Studies	1	1	0	1	Basic Sciences
22MS201	Management Science	2	2	0	3	Humanities
	Department Elective – 1	2	0	2	3	Department Elective
	Open Elective – 1	2	0	2	3	Open Elective
22SA202	Life Skills - II	0	0	2	1	Binary grade
Total		**12**	**3**	**14**	**20**	
	Minor / Honours - 1	3	0	2	4	
Total		**34 Hrs**			**24**	

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

COURSE STRUCTURE - R22

III Year I Semester

Course Code	Course Title	L	T	P	C	Course category
22TP301	Soft Skills Laboratory	0	0	2	1	Humanities
22BI301	Immunology and Immunoinformatics	3	0	2	4	Professional core
22BI302	Molecular Modelling and Simulations	3	0	2	4	Professional core
22BI303	R Programming for Biological Data Sciences	3	0	2	4	Professional core
	Department Elective – 2	2	0	2	3	Department Elective
	Open Elective – 2	2	0	2	3	Open Elective
22BI305	Industry interface course (Modular course)	1	0	0	1	Binary Grades
22BI304	Inter-Departmental Project / Course	0	0	2	0	Project
Total		**14**	**0**	**14**	**20**	
	NCC/ NSS/ SAC/ E-cell/ Student Mentoring/ Social activities/ Publication.	0	0	0	1	Floating credits Binary grade
	Minor / Honours - 2	3	0	2	4	
Total			**33**		**24**	
		33 Hrs				

III Year II Semester

Course Code	Course Title	L	T	P	C	Course category
22TP302	Quantitative aptitude and Logical reasoning	1	0	2	2	Humanities
22BI306	Data mining and Machine Learning for Bioinformatics	3	0	2	4	Professional core
22BI307	Molecular Phylogenetics	2	0	2	3	Professional core
	Department Elective – 3	2	0	2	3	Department Elective
	Department Elective – 4	2	0	2	3	Department Elective
	Open Elective – 3	2	0	2	3	Open Elective
22BI308	Inter-Departmental Project/Course	0	0	2	2	Project
Total		**12**	**0**	**14**	**20**	
	Minor / Honours - 3	3	0	2	4	
Total			**31**		**24**	
		31 Hrs				

COURSE STRUCTURE - R22

R22 B.Tech.
4 YEAR
DEGREE PROGRAMME

IV Year I Semester

Course Code	Course Title	L	T	P	C	Course category
22BI401	Next Generation Sequencing	3	0	2	4	Professional core
22BI402	Systems Biology	3	0	2	4	Professional core
	Department Elective – 5	2	0	2	3	Department Elective
	Department Elective – 6	2	0	2	3	Department Elective
	Department Elective – 7	2	0	2	3	Department Elective
	Department Elective – 8	2	0	2	3	Department Elective
	Total	**14**	**0**	**12**	**20**	
	Minor / Honours – 4	3	0	2	4	
	Total	**31**			**24**	
		31 Hrs				

IV Year II Semester

Course Code	Course Title	L	T	P	C	Course category
22BI403	Internship / Project Work	0	2#	22	12	Project
	Total				**12**	
	Minor / Honours – 5 (for project)	0	2	6	4	Theory course may be also offered
	Total	**32**			**16**	
		32 Hrs				

for interaction between Guide and students

R22 B.Tech. 4 YEAR DEGREE PROGRAMME

COURSE STRUCTURE - R22

Department Electives

Course Code	Course Title	L	T	P	C
22BI801	Bioperl (M)	2	0	2	3
22BI802	Bioprocess Economics, Modeling and Simulations	2	2	0	3
22BI803	Clinical Data Management	2	0	2	3
22BI804	Expression Data and Image Analysis	2	0	2	3
22BI805	Health Analytics	2	0	2	3
22BI806	Neural Networks	2	0	2	3
22BI807	Probiotics and Food Microbiology	2	0	2	3
22BT803	Bioenergetics	2	2	0	3
22BT805	Biopharmaceutical Technology	2	2	0	3
22BT807	Genomics and Proteomics	2	0	2	3
22BT809	Metabolic Engineering	2	0	2	3
22BT815	Vaccinology	2	0	2	3
22BT819	Computer-Aided Drug Design (M)	2	0	2	3
22BT822	Health Informatics (M)	2	2	0	3
22BT828	Regulatory affairs and clinical trails	2	2	0	3
22BI808	Biological Big Data Management and Analytics	2	0	2	3
22BI809	Cheminformatics and QSAR	2	0	2	3
22BI810	Good Laboratory Practices	2	0	2	3
22BI811	Synthetic biology (M)	2	0	2	3
22BT801	3D Bioprinting	2	2	0	3
22BT804	Bioethics and Intellectual Property Rights (M)	2	2	0	3
22BT810	Phage Display	2	2	0	3
22BT811	Phytopharma	2	0	2	3
22BT813	Plant Tissue Culture and Transgenics	2	0	2	3
22BT817	Biosensors	2	2	0	3

Honours - OMICS

The branches of science known informally as omics are various disciplines in biology whose names end in the suffix-omics such as genomics, proteomics, metabolomics, metagenomics, phenomics and transcriptomics. This honours program on "Omics" aims at the collective characterization and quantification of pools of biological molecules that translate into the structure, function and dynamics of organisms.

Course Code	Course Title	L	T	P	C
22BI951	Pharmacogenomics	3	-	2	4
22BI952	Metabolomics	3	-	2	4
22BI953	Comparative and Functional Genomics	3	-	2	4
22BT953	Metagenomics	3	-	2	4
22BI954	Project / Open source – Swayam/NPTEL	0	2	6	4
Total		**12**	**2**	**14**	**20**

I

YEAR

B.Tech.

BIOINFORMATICS

I SEMESTER

22MT101	-	Elementary Mathematics
22PY101	-	Applied Physics
22EE101	-	Basics of Electrical and Electronics Engineering
22BT103	-	IT Workshop and Bioproducts
22TP103	-	Programming in C
22EN102	-	English Proficiency and Communication Skills
22SA101	-	Physical Fitness, Sports and Games – I
22TP101	-	Constitution of India

II SEMESTER

22MT110	-	Matrices and Differential Equations
22CT104	-	Organic Chemistry
22TP104	-	Basic Coding Competency
22ME101	-	Engineering Graphics
22EN104	-	Technical English Communication
22BT101	-	Cell and Molecular Biology
22SA103	-	Physical Fitness, Sports & Games – II
22SA102	-	Orientation Session

COURSE CONTENTS

I SEM & II SEM

22MT101 ELEMENTARY MATHEMATICS

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basics of Geometry and Algebra.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to make student acquainted with preliminary concepts of mathematics that are useful for their engineering study. Students will learn concepts of progression, partial fractions, straight line, trigonometry, calculus which will help them to apply in various aspects of engineering fields.

MODULE-1

UNIT-1 **12L+8T+0P=20 Hours**

MATHEMATICAL PRELIMINARIES

Partial fractions, Arithmetic progressions, Geometric progressions.

UNIT-2 **12L+8T+0P=20 Hours**

STRAIGHT LINES AND TRIGONOMETRIC RATIOS

Straight lines: Point in coordinate plane, distance formula, straight line, slope, equation of straight in different forms.

Trigonometric ratios: Trigonometric ratios, values in different quadrants, compound angels, multiple angles.

PRACTICES

- Splitting a given improper fraction
- Finding the general term and sum of infinite terms of a progression.
- Finding equation of a straight line in various form
- Find the tangent and normal.
- Evaluation of trigonometric function.

MODULE-2

UNIT-1 **12L+8T+0P=20Hours**

CALCULUS

Differential Calculus: Introduction to differentiation, Derivatives of simple functions, Product rule, Quotient rule and Chain rule of differentiation.

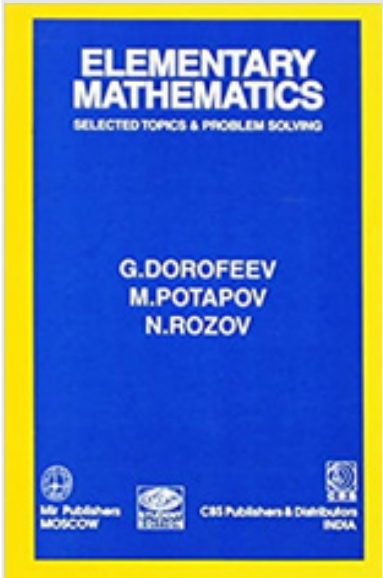
Integral calculus: Integration as anti-derivative process, Standard forms, Methods of integration: by substitution, by parts, and by partial fractions.

Definite integration.

UNIT-2 **12L+8T+0P=20Hours**

APPLICATIONS OF CALCULUS

Tangent, normal, velocity and acceleration. Evaluation of length and area by integration



Source : https://www.amazon.in/Elementary-Mathematics-G-Dorofeev/dp/8123908423/r_1_3?crid=1N1QBXQPFWH7Q&keywords=elementary+mathematics&qid=1661240301&s=books&sprefix=elementary+mathematics%2Cstripbooks%2C210&sr=1-3

SKILLS:

- ✓ *Focusing on Trigonometric Ideas.*
- ✓ *Know the various trigonometric functions.*
- ✓ *Understanding the Applications of Trigonometry and straight lines.*
- ✓ *Understand basic applications of calculus*

PRACTICES:

- To calculate the profit and loss in business using graphs.
- To check the temperature variation.
- To determine the speed or distance covered.
- Derivatives and integration are used to derive many equations in Physics.
- In the study of Seismology like to find the range of magnitudes of the earthquake.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of straight line in real life problems.	Apply	1	1, 2, 9, 10, 12
2	Apply the concepts of calculus in real life problem.	Apply	2	1, 2, 9, 10, 12
3	Distinguish between finite and infinite AP and determine the general term.	Analyse	1	1, 2, 9, 10, 12
4	Categorize right angle triangles to evaluate the trigonometric ratios.	Analyse	2	1, 2, 9, 10, 12

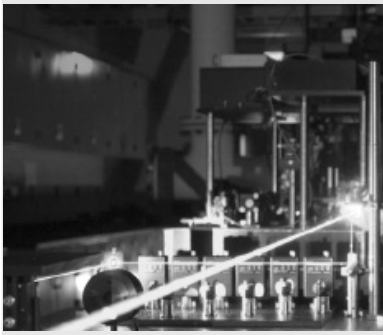
TEXT BOOKS:

1. 1. John Bird, “Higher Engineering Mathematics”, 2nd edition, Routledge (Taylor & Francis Group), London, New York, 2018.
2. Veerarajan, T., “Engineering Mathematics”, 3rd edition, Tata McGraw Hill Publishing Co., New Delhi, 2019

REFERENCE BOOKS:

1. P. Kandasamy, K. Thilagavathy, K.Gunavathy, “Engineering Mathematics”, 3rd edition, S.Chand& Co., New Delhi, 2017.
2. P. Seshagiri Rao, “A Text Book of Remedial Mathematics”, 3rd edition, PharmaMed Press / BSP Books, 2018.
3. Nabjyoti Dutta, Bulendra Limboo, Bismeeta Buragohain, Pranjal Talukdar, “A Basic Course in Mathematics for Polytechnic Vol.1, Vol.2”,Second Edition, Mahaveer Publications, 2017.

22PY101 APPLIED PHYSICS



https://www.google.com

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of atomic structure and electronic transitions, Bonding in solids, and concept of waves.

COURSE DESCRIPTION AND OBJECTIVES:

The purpose of this course is to present the principles and concepts of Light and Sound waves. It enunciates the concurrent understanding of Lasers and Optical Fibers. It emphasizes on the principles and applications of Nano materials as relevant to an Engineer.

MODULE-1

UNIT-1 **8L+0T+8P = 16 Hours**

PHYSICAL OPTICS

Interference: Introduction-Superposition principle -Types of superposition of waves – Division of wave front, Division of amplitude, Newton rings- Experiment – Diameter of Newton rings (bright & dark), Determination of wavelength – Determination of Refractive Index.

Diffraction: Introduction- Interference versus Diffraction – Types of diffraction, Fraunhofer diffraction at single and double slit (qualitative), Plane transmission diffraction grating (Qualitative) – Determination of wavelength.

Polarization: Polarized and unpolarized light, Production of polarized light, Nicol prism, Quarter and half wave plates, Optical activity - Laurent's half shade polarimeter.

UNIT-2 **8L+0T+8P = 16 Hours**

LASERS AND FIBRE OPTICS

LASERS: Characteristics of laser light – spontaneous and stimulated emission, Population Inversion – Pumping Processes –He-Ne laser, Semiconductor laser and applications of lasers, Holography – construction – reconstruction and applications.

Fiber Optics: Principle of optical fibre – acceptance angle, numerical aperture, Types of fibres– Step Index fiber – Gradded Index fiber - Fibre optic sensor-Biosensors.

PRACTICES:

- Newtons rings: Determination of wavelength of a given light source.
- Diffraction grating: Determination of wavelength – Normal Incidence method.
- Polarimeter: Determination of Optical rotation of an optically active solution.
- Laser: Determination of wavelength of a given LASER source using plane diffraction grating.

MODULE-2

UNIT-1 **8L+0T+8P = 16 Hours**

CRYSTAL PHYSICS

Crystal Physics: Introduction-Fundamental terms of crystal physics, Lattice parameters and Crystal systems, packing factor for SC, BCC and FCC –Miller indices – Rules to find Miller Indices – Important features of Miller Indices – Distance of separation between successive (h k l) planes (Qualitative), XRD and Bragg's law.

SKILLS:

- ✓ *Apply the dynamics of Light to realize the various potential applications in Engineering.*
- ✓ *Evaluate the concepts of Lasers and Optical Fibers to realize versatile applications in Science, Engineering and Technology.*
- ✓ *Analyze the Crystal Structures and orientation of planes.*
- ✓ *Appraise the importance of Ultrasonics in medicine.*
- ✓ *Demonstrate the synthesis and characterization of Nano materials in view of their applications.*

UNIT-2 **8L+0T+8P = 16 Hours**

ELEMENTS OF NANOMATERIALS

Elements of Nano Materials: Introduction- Principles of Nano materials, Synthesis of Nanomaterials: top- down and bottom- up approaches – Ballmilling – Sol-gel, Applications of nanomaterials, Characterization of nanomaterials by electron microscopy (SEM-Construction – Working – Applications), TEM- (Construction – Working – Applications), AFM – Construction – Working – Applications.

PRACTICES:

- Band gap: Determination of Energy bandgap of a semiconductor.
- Optical fibre: Determination of a Numerical Aperture of an Optical Fibre.
- LED: Study of V-I characteristics of LED.
- Ultrasonic interferometer: Determination of Ultrasonic wave velocity in liquid medium.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the concepts of Physical Optics in the perspective of Engineering applications.	Apply	1	1, 3, 5, 6, 7
2	Analyse the wavelengths of Laser for applications in medicine and to foster the knowledge on Optical Fibers to realize Fiber Optic Sensors.	Analyze	1	1, 3, 5, 6, 7
3	Recognise the importance of Crystal Physics relevant to Bio-Physical systems.	Apply	2	1, 2, 4, 5, 6, 7, 9
4	Evaluate Ultrasonic waves to apply them in medical diagnostics.	Evaluate	2	1, 2, 4, 5, 6, 7, 9
5	Connect the dimensions of Nano particles to consolidate the Physical and Chemical aspects of Nano materials.	Analyze	2	1, 3, 5, 6, 9, 11, 12

TEXT BOOKS:

1. S.O.Pillai, “Solid State Physics”, New age International publishers, 8th edition, 2018.
2. M.R. Srinivasan, “Engineering Physics”, New Age International Publishers, 1st edition 2008.

REFERENCE BOOKS:

1. M.N. Avadhanulu, P.G. Kshirsagar and T.V.S. Aruen Murthy, “A Text Book of Engineering Physics”, 11th edition, S. Chand & Company Ltd., 2019.
2. Shatendra Sharma and Jyotsna Sharma, “Engineering Physics”, 1st edition, Pearson India Education Services Pvt. Ltd., 2018.
3. D. Halliday, R. Resnick and J. Walker “Fundamentals of Physics”, 6th edition, John Wiley and Sons, 2020.
4. T. Pradeep, “A Text Book of Nanoscience and Nanotechnology”, 1st edition, Tata Mc-Graw Hill, 2018.

22EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Source : https://vita.vision.org.in/emerging-technologies-in-electrical-engineering/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Electrostatics and electromagnetism.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides an insight into the functioning of basic electrical components like resistor, inductor and capacitor. It deals with the constructional and operational details of AC machines. It also deals with the basic electronic components like P-N junction diode, Zener diode, Transistor and their characteristics.

MODULE–1

UNIT-1 **8L+0T+8P=16 Hours**

FUNDAMENTALS OF ELECTRIC CIRCUITS

DC Circuits: Concept of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Ohm's Law, Kirchhoff's Laws, Application to simple series, Parallel circuits, Mesh and nodal analysis of resistive circuits with DC source.

AC circuits: Generation of AC voltage, Frequency, Average value, R.M.S. value, Form factor, Peak factor for sinusoidal only;

UNIT-2 **8L+0T+8P=16Hours**

SEMICONDUCTOR DEVICES

Classification of semiconductors, P-N junction diode -operation and its characteristics, Half wave rectifier - operation, efficiency; Full wave rectifiers -types, operation, efficiency; Zener diode and its characteristics, Zener diode as Voltage regulator.

Bi polar junction transistor- operation, types (NPN & PNP).

PRACTICES:

- Verification of Ohm's law.
- Verification of Kirchhoff's current law.
- Verification of Kirchhoff's voltage law.
- Determination of R.M.S. Values of sinusoidal waveform.
- Verification of PN junction diode characteristics under both forward and reverse bias.
- Verification of Zener diode characteristics under reverse bias.

MODULE–2

UNIT-1 **8L+0T+8P=16Hours**

ANALYSIS OF AC CIRCUITS

Analysis of single- phase ac circuits consisting of R, L, C, RL, RC (series and parallel) (simple numerical problems). Introduction to three phase system, Relation between phase and line quantities of voltages and currents in star and delta connected systems (Elementary treatment only).

SKILLS:

- ✓ *Distinguish between linear and nonlinear elements by looking at VI characteristics.*
- ✓ *Develop a simple loop generator.*
- ✓ *Design a voltage regulator using Zener diode.*
- ✓ *Design a half wave rectifier using PN junction diode.*
- ✓ *Design a full wave rectifier using PN junction diodes.*

UNIT-2 **8L+0T+8P=16Hours**

AC MACHINES

Electromagnetism: Concepts of Magneto motive force, Reluctance, Flux and flux density, Concept of self-inductance and mutual inductance, Coefficient of coupling.

Static AC Machine: Principle of operation of single phase transformer, Constructional features, EMF equation (simple numerical problems).

Rotating AC Machine Principle of operation of three phase induction motor, Slip ring and squirrel cage motors, Torque equation; Constructional details of synchronous machine.

PRACTICES:

- Transformation ratio of a single phase transformer at different loads.
- Measurement of Energy in single phase resistive load circuit.
- Measurement of Power in single phase resistive load circuit.
- Determination of impedance in complex AC circuits.
- Verification of line and phase quantities in a balanced three phase system.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the resistive circuits with independent sources and find its solution.	Analyze	1,2	1,2,6,9
2	Solve the AC (single and three phase) and DC circuits using different methods.	Apply	1,2	1,2,9,12
3	Apply the concepts of electromagnetism for its applications.	Apply	2	1,2,3,9,12
4	Examine the different electrical equipment.	Evaluate	2	1,2,9,12
5	Acquire the knowledge of semiconductor devices to create circuits.	Create	1	1,2,3,9,12

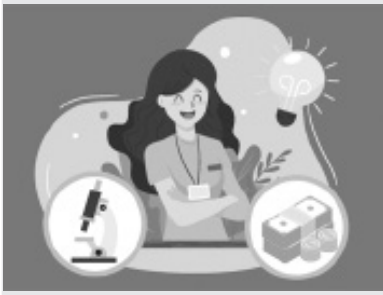
TEXT BOOKS:

1. V. K. Mehta, “Principles of Electrical Engineering and Electronics”, 1st edition, S.Chand& Co., Publications, New Delhi, 2019.
2. D.P. Kothari, “Basic Electrical and Electronics Engineering”, 2nd edition, TMH, New Delhi, 2017.

REFERENCE BOOKS:

1. Millman and Halkias, “Electronic Devices and Circuits”, 1st edition, Mc Graw Hill, 2006.
2. A.K. Thereja and B.L.Thereja, “Electrical Technology”, Vol.–II, 1st edition, S. Chand & Co., Publications, 2020.
3. U. Bakshi and A. Bakshi, “Basic Electrical Engineering”, 1st edition, Technical Publications, Pune, Nov 2020.

22BT103 IT WORKSHOP AND BIOPRODUCTS



Source : https://www.gramedia.com/pendidikan/jurusan-bioentrepreneurship/

Hours Per Week :

L	T	P	C
1	0	4	3

PREREQUISITE KNOWLEDGE:

Basic idea of computer,Basics of biology

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with different IT tools and commercial bioproducts. The objective of this course is giving hands on practice on assembling and disassembling, word, spreadsheets and presentations and also knowledge on various bioproducts.

MODULE-1

UNIT-1 **3L+0T+12P=15 Hours**

Computer Hardware: Peripherals of a computer, components in a CPU and its functions, block diagram of the CPU.

Tools for Report writing and Presentation: Overview and Installation of Microsoft Word, Excel and Power Point Presentation.

UNIT-2 **5L+0T+20P=25 Hours**

Computer Hardware: Disassemble and Assemble the PC back to working condition.

Tools for Report writing and Presentation: Creating project, creating a Newsletter using Microsoft Word;Creating a Scheduler, Calculating GPA, Performance Analysis, Conditional Formatting, Charts and Pivot Tables using MS Excel; Power Point utilities and tools, Master Layouts, Design Templates, Background and textures using Power Point Presentation.

PRACTICES:

- Troubleshooting of a computer hardware.
- Assembly and disassembly of a computer.
- Creation of projects and newsletter using MS Word.
- Spreadsheet basics, modifying worksheets, formatting cells, formulas and functions, sorting and filtering, charts using MS Excel.
- Power point screen, working with slides, add content, work with text, working with tables, graphics, slide animation, reordering slides, adding sound to a presentation using MS PPT.

MODULE-2

UNIT-1 **2L+0T+8P=10 Hours**

TYPES OF BIO-PRODUCTS

Definition of bio-products, categories of bio-products, importance of bio-products, bio-products used for decoration, biofertilizers and clonal propagation of plants, Socio-economic and environmental impact of bioproducts.

SKILLS:

- ✓ *Use of computer tools in academic and project works*
- ✓ *Development of process for various bioproducts*
- ✓ *Analyse bio-products market trend.*

UNIT-2 **6L+0T+24P=30 Hours**

BIO-MATERIALS AND BIO-FUELS

Liquid fuels-ethanol and biodiesel, solid biomass for combustion to generate heat and power, Gaseous fuel such as biogas, Bio-plastics from plant oils, Bio-rubber from latex, Bio-composites from agriculture (Ex. Hemp, flax and kenaf), Bio-fibers from flax, Biopolymers from renewable sources.

PRACTICES:

- Survey of bio-products and their market value in the last five years.
- A report on the functioning of GPS Biogas unit from food waste installed in VFSTR continuously for 15 days.
- Industrial applications of bio-plastics, bio-rubber, bio-composites and biofibers.
- Alternate energy from solid biomass: Preparation of flow chart depicting the process.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of computer hardware in trouble shooting.	Apply	1	1,3,6,7
2	Create projects and Newsletter using MS Word.	Create	1	3,4,7
3	Analyze various methods for the production of novel bio-products.	Analyze	2	2,4,6,7
4	Develop sustainable biomaterials from renewable sources for commercial and health benefits.	Develop	2	3,67
5	Evaluate the importance of green entrepreneurship.	Evaluate	2	3,4,7

TEXT BOOKS:

1. Peter Norton, “Introduction to Computers”, Tata Mc Graw Hill Publishers, 7th Edition, 2017.
2. N TDunford, “Food and Industrial Bioproducts and Bioprocessing”, 1st edition, Wiley-Blackwell, 2012.
3. Christoph W, James C. Liao, Sang Y. Lee, Jens N and Gregory S, “Industrial Biotechnology: ProductsandProcess”, 1st edition, Wiley, 2017.

REFERENCE BOOKS:

1. James W. Lee, “Advance Biofuels and Bioproducts”, 1stedition, Springer, 2013.
2. G. Chen, Randall J. Weselake and Stacy D. Singer, “Plant Bioproducts”, 1st edition, Springer, 2018.
3. GrahamPBunn, “Good manufacturing Practices for Pharmaceuticals”, 7th edition, Taylor & Francis, 2021.
4. Sandy Weinberg, “Good laboratory Practice regulations”, 4th edition, Taylor & Francis, 2007.

22TP103 PROGRAMMING IN C

Source : https://www.gramedia.com/pendidikan/jurusan-bioentrepreneurship/

Hours Per Week :

L	T	P	C
2	0	4	4

PREREQUISITE KNOWLEDGE: Fundamentals of Problem Solving.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on basic concepts of C programming language and problem solving through programming. It covers basic structure of C program, data types, operators, decision making statements, loops, functions, strings, pointers, and also file manipulations. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE- 1

UNIT-1 **8L+0T+16P=24 Hours**

INTRODUCTION TO ALGORITHMS AND PROGRAMMING LANGUAGES

Introduction to Algorithms: Basics of algorithms, Flow charts, Generations of programming languages, Introduction to C: Structure of a C program - pre-processor statement, inline comments, variable declaration statements, executable statements, C Tokens - C character set, identifiers and keywords, type qualifiers, type modifiers, variables, constants, punctuations and operators.

Data Types and Operators: Basic data types, Storage classes, Scope of a variable, Formatted I/O, Reading and writing characters, Operators - assignment, arithmetic, relational, logical, bitwise, ternary, address, indirection, sizeof, dot, arrow, parentheses operators, Expressions - operator precedence, associative rules.

Control Statements: Introduction to category of control statements, Conditional branching statements - if, if– else, nested-if, if – else ladder, switch case, Iterative statements - for, while, do - while, nested loops, Jump statements - break, jump, goto and continue.

UNIT-2 **8L+0T+16P=24 Hours**

ARRAYS & STRINGS

Arrays: Introduction, Types of arrays; Single dimensional array - declaration, initialization, usage, reading, writing, accessing, memory representation, operations, Multi dimensional arrays.

Strings: Character array, Reading string from the standard input device, Displaying strings on the standard output device, Importance of terminating a string, Standard string library functions.

Practice Questions on Data Handling – Level 1:

1. Write a program to accept a character as input from the user and print it.
2. Write a program to accept a number as input from the user and print it.
3. Write a program to accept a float value from the user and print it.
4. Write a program to accept a message as input from the user and print it.
5. Write a program to accept a message from the user as input and print it in 3 different lines.
6. Write a program to accept 2 numbers from the user as input and print their sum.
7. Write a program to accept 2 numbers from the user as input and print their product.
8. Write a program to accept a number as input from the user which denotes the temperature in Celsius, convert it to Fahrenheit reading and print it.

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Select static or dynamic data structures for a given problem and manipulation of data items.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

9. Write a program to accept a number as input from the user which denotes the radius and print the area of the circle.
10. Write a program to accept a character as input from the user and print it's corresponding ASCII value.

Questions on Control Statements - Looping – Level 1:

1. Write a C program to print all the characters from a to z once.
2. Write a C program to print all the characters from Z to A once.
3. Write a C program to print all the characters from A to Z 3 times.
4. Write a C program to print the first N natural numbers, where N is given as input by the user.
5. Write a C program to print the first N natural numbers and their sum, where N is given as input by the user.
6. Write a C program to print all the odd numbers between 1 and N where N is given as input by the user.
7. Write a C program to print all the even numbers between I and N where N is given as input by the user.
8. Write a C program to print the squares of the first N natural numbers between 1 and N, where N is given as input by the user.
9. Write a C program to print the cubes of the first N natural numbers between 1 and N, where N is given as input by the user.
10. Write a C program to print the squares of every 5th number starting from 1 to N, where N is given as input by the user.

Questions on Control Statements – Decision Making – Level 1:

1. Write a program to accept two numbers as input check if they are equal.
2. Write a program to accept two characters as input and check if they are equal.
3. Write a program to accept two numbers as input and print the greater of the 2 numbers.
4. Write a program to accept two numbers as input and print the lesser of the 2 numbers.
5. Write a program to accept 3 numbers as input and print the maximum of the 3.
6. Write a program to accept 3 numbers as input and print the minimum of the 3.
7. Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
8. Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
9. Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
10. Write a program to accept a number as input and check if it is positive, negative or zero.

Questions on Patterns – Level 1:

1. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

   *****

   *****

   *****

   *****

   *****

2. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

   *****

   * *

   * *

   * *

   *****

3. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*
**
***
****
*****
```

4. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
*
**
***
****
*****
```

5. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
12
123
1234
12345
```

6. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
1
22
333
4444
55555
```

7. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
54321
4321
321
21
1
```

8. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
12345
2345
345
45
5
```

9. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

```
A
AB
ABC
ABCD
ABCDE
```

10. Write a program to accept a number N as input from the user and print the following pattern. Sample N = 5.

    A

    BC

    DEF

    GHIJ

    KLMNO

Questions on Number Crunching – Level 1:

1. Write a program to accept a number as input and print the number of digits in the number.
2. Write a program to accept a number as input print the sum of its digits.
3. Write a program to accept a number as input, reverse the number and print it.
4. Write a program to accept a number and digit as input and find the number of occurrences of the digit in the number.
5. Write a program to accept a number as input and check if it is an Armstrong number.
6. Write a program to accept a number as input and check if it is an Adam number.
7. Write a program to accept a number as input and check if is a prime number.
8. Write a program to accept 2 numbers as input and check if they are amicable or not.
9. Write a program to accept a number as input and check if it is a power of 2.
10. Write a program to accept 2 numbers as input and find their LCM.

Questions on Arrays – Level 1:

1. Print the contents of an array from the left to the right.
2. Print the contents of an array from the right to the left.
3. Find the sum of the elements of an array.
4. Find the maximum element in an unsorted array.
5. Find the minimum element in an unsorted array.
6. Find the average of the elements in an unsorted array.
7. Count the number of 0s and 1s in an array having 0s and 1s in random order.
8. Count the number of elements in an array whose elements are lesser than a key element in an unsorted array.
9. Print all the elements in an array whose values are lesser than a key element in an unsorted array.
10. Find the repeated elements in a sorted array.

Questions Number crunching – Level 2:

1. Write a program to accept a number as input and print the product of its digits.
2. Write a program to accept a number as input and check if it is a palindrome.
3. Write a program to accept a number as input and print the frequency of occurrence of each digit.
4. Write a program to accept a number as input and print its factors.
5. Write a program to accept a number as input and print its prime factors.
6. Write a program to accept a number as input and check if it is a perfect square of not.
7. Write a program to accept 2 numbers as input and check if they are betrothed numbers or not.
8. Write a program to accept 2 numbers as input and print their HCF.
9. Write a program to accept a number as input and check if is a strong number.
10. Write a program to generate prime numbers between two intervals given as input.

Questions on Arrays – Level 2:

1. Find the sum of the maximum and minimum numbers of an unsorted array.
2. Replace every element in an array with the sum of its every other element.
3. Replace every element in an array with the sum of its right side elements.
4. Replace every element in an array with the sum of its left side elements.
5. Reverse the elements of an array (in place replacement).
6. Reverse the first half of an array.
7. Reverse the second half of an array.
8. Write a program to find the second largest element in an unsorted array.
9. Write a program to find the second smallest element in an unsorted array.
10. Write a program to print the number of odd and even numbers in an unsorted array.

Questions on Strings – Level 1:

1. Write a program to accept a string as input and print it.
2. Write a program to accept a string as input and count the number of vowels in it.
3. Write a program to accept a string as input and count the number of consonants in it.
4. Write a program to accept a string as input and print its length.
5. Write a program to accept a string as input and print the reversed string.
6. Write a program to accept 2 strings as input and check if they are the same.
7. Write a program to accept a string as input and copy the contents into a second string and print the second string.
8. Write a program to accept 2 strings as input and concatenate them into a third string and print the third string.
9. Write a program to accept a string as input and check if it is a palindrome.
10. Write a program to accept two strings as input and check if the second string is a substring of the first.

Questions on Strings – Level 2:

1. Implement the string length function.
2. Implement the string copy function.
3. Implement the string concatenate function.
4. Implement the string compare function.
5. Implement the vowel count function.
6. Implement the consonant count function.
7. Implement the count words function.
8. Implement the string reverse function.
9. Implement the strstr function.
10. Complete the code snippet to implement the is Palindrome function that checks if a given string is a palindrome. You will need to use the 3 functions string Copy, strReverse and string Compare functions provided to accomplish this.

MODULE-2

UNIT-1 **8L+0T+16P=24 Hours**

FUNCTIONS& POINTERS

User-defined functions: Function declaration - definition, header of a function, body of a function, function invocation, Call by value, Call by address, Passing arrays to functions, Command line arguments, Recursion, Library Functions.

Pointers: Declaration, Initialization, Multiple indirection, Pointer arithmetic, Relationship between arrays and pointers, Scaling up - array of arrays, array of pointers, pointer to a pointer and pointer to an array; Dynamic memory allocation functions.

UNIT-2 **8L+0T+16P=24 Hours**

STRUCTURES, UNIONS & FILES

Structures: Defining a structure, Declaring structure variable, Operations on structures, Pointers to structure - declaring pointer to a structure, accessing structure members using pointer, Array of structures, Nested structures, Passing structures to functions - passing each member of a structure as a separate argument, passing structure variable by value, passing structure variable by reference/ address, Typedef and structures.

Unions: Defining a union - declaring union variable, operations on union, Pointers to union - declaring pointer to a union, accessing union members using pointer, Array of union, Nested union, Typedef and union, Enumerations, Bit-fields.

Files: Introduction to files, Streams, I/O using streams – opening a stream, closing stream, Character input, Character output, File position indicator, End of file and errors, Line input and line output, Formatted I/O, Block input and output, File type, Files and command line arguments.

PRACTICES:

Questions on Strings – Level 3:

1. Write a program to swap two given strings and print the swapped strings.
2. Write a program to swap two given words of the given sentence and print the altered string.
3. Return the maximum occurring character in the string.
4. Write a program to print the character in the string with the count where count is the occurrence of the character.
5. Write a program to print the duplicate characters in the given string.
6. Write a program to remove the duplicate characters in the given string.
7. Write a program to remove the vowels from a given string.
8. Write a program to rotate a given string N number of times.
9. Write a program to check if 2 strings are rotations of each other.
10. Write a program to remove the characters from the first string that are present in the second string.

Questions on 2D Arrays – Level 1:

1. Print the contents of a 2D array row-wise.
2. Print the contents of a 2D array column-wise.
3. Print the contents of a 2D array in a zig-zag order.
4. Print the contents of a 2D array diagonal-wise.
5. Print the contents of a 2D array right-diagonal order.
6. Print the contents of a 2D array left-diagonal order.
7. Print the contents of a 2D array in the upper triangular order – left top to right bottom.
8. Print the contents of a 2D array in the lower triangular order.
9. Find and print the maximum element along with its position in a matrix.
10. Find and print the minimum element along with its position in a matrix.

Questions on 2D Arrays – Level 2:

1. Find and print the maximum element of each row of a matrix.
2. Find and print the minimum elements of each row of a matrix.
3. Find and print the maximum element of each column of a matrix.
4. Find and print the minimum element of each column of a matrix.

5. Find the lowest value in the upper triangle area and the largest value in the lower triangular area of a matrix and print their product.
6. Find the sum of the elements of each row and each column of a matrix and print the minimum row sum and maximum sum column.
7. Write a program to find the row with the maximum number of 1's in a matrix consisting of only 0's and 1's.
8. Write a program to print the quotient and remainder on dividing sum of left-top to right-bottom diagonal by sum of right-top to left-bottom diagonal.
9. Write a program to print the absolute difference of the sum of major diagonal elements and the sum of minor diagonals of the given matrix.
10. Write a program to search a given element in a row-wise and column-wise sorted 2D array.

Questions on 2D Arrays – Level 3:

1. Write a program to find the Kth smallest element in the given matrix.
2. Write a program to find the Kth largest element in the given matrix.
3. Write a program to check whether the given two two-dimensional array of same dimensions are equal or not.
4. Write a program to add the given two two-dimensional array of same dimensions.
5. Write a program to subtract the given two two-dimensional array of same dimensions.
6. Write a program to multiply the given two two-dimensional array of same dimensions.
7. Write a program to sort each row of a matrix.
8. Write a program to find the sum of the elements in 'Z' sequence of the given 2D array.
9. Write a program to print the unique rows of the given two-dimensional array consisting of only 0's and 1's.
10. Write a program to print the unique columns of the given two-dimensional array consisting of only 0's and 1's.

Questions on Files, Structures & Unions:

1. Write a C program to create a struct, named Student, representing the student's details as follows: first_name, last_name, Age and standard.

   Example
   Read student data
   john
   carmack
   15
   10
   Display the data in the following format
   First Name: john
   Last Name: carmack
   Age: 15
   Standard: 10
2. Declare a structure POINT. Input the coordinates of point variable and write a C program to determine the quadrant in which it lies. The following table can be used to determine the quadrant.

Quadrant	X	Y
1	Positive	Positive
2	Negative	Positive
3	Negative	Negative
4	Positive	Negative

Example

Input the values for X and Y coordinate: 7 9

The coordinate point (7,9) lies in the First quadrant.

3. Bob and Alice both are friends. Bob asked Alice how to store the information of the books using Structures. Then Alice written a c program to store the information of books using book structure by taking different attributes like book_name, author, book_id, price. Write a C program to read and display the attributes of the books using structures.

   Sample Input:

   Enter number of books: 1

   Enter the book name: c Programming

   Enter the author name: balaguruswamy

   Enter the book ID: 23413

   Enter the book price: 500

   Sample Output:

   The details of the book are:

   The book name is: c Programming

   The author name is: balaguruswamy

   The book ID is: 23413

   The book price is: 500.00

4. Ramesh wants to do addition on complex numbers. He did it with regular practice but Charan asked him to do with the help of structures by following below Criteria.

   Write a C program that defines a structure named 'Complex' consisting of two floating point members called "real and imaginary". Let c1 and c2 are two Complex variables; compute the sum of two variables.

   Example:

   c1= 2 8

   c2= 6 4

   Sum= 8.000000+12.000000i

5. Customer Payment Details is a structure with members as customers_name, address, account_number, payment_status(paid(1)/ not_paid(0)), due_date, and amount. In this example, payment_date is another structure with month, day and year as integer members. So, every customer record can be considered as an array of structures.

   Write a C program that displays the amount to be paid by each customer along with their names. If payment_status is 1, display NIL for such customers.

   Input Format:

   First line of input contains 'n' number of customers, followed by 8 lines of input for each customer. Each line represents (customers_name, address, account_number, amount payment_status(paid(1)/ not_paid(0)), and due_date).

   Output Format: First line of output is Amount to be paid by each customer as on date: followed by n lines of output. Each line contains name of the customer followed by tab space, and amount to be paid.

   Hint: Use nested structure to represent date.

   Write a 'C' program to accept customer details such as: Account_no, Name, Balance using structure. Assume 3 customers in the bank. Write a function to print the account no. and name of each customer whose balance < 100 Rs.

6. Write a C program to accept details of 'n' employee(eno, ename, salary) and display the details of employee having highest salary. Use array of structure.

7. Write a C program to print the bill details of 'N' number of customers with the following data: meter number, customer name, no of units consumed, bill date, last date to deposit and city. The bill is to be calculated according to the following conditions:

No. of units	Charges
For first 100 units	Rs.0.75 per unit
For the next 200 units	Rs.1.80 per unit
For the next 200 units	Rs.2.75 per unit

Sample Input

Enter no. of customers
1
Enter Meter Number AP01213
Enter Customer Name: Karthik
Enter No. of units consumed: 200
Enter Bill date:22/01/2021
Enter Last date: 12/2/2021
Enter City: Guntur
Sample Output
Meter Number AP01213
Customer Name: Karthik
No. of units consumed: 200
Bill date:22/01/2021
Last date: 12/2/2021
City: Guntur
Total Amount: 255.000000

8. Write a C program that creates a student file containing {Roll No, Student Name, Address, Stream}, where the data will be inserted and display the list of students who are in CSE (Stream=CSE).

   Input: A file name

   Output: The attributes such as Roll_No, Student_Name, Stream, Address.

   Sample Input

201fa4200	Raja	CSE	Guntur
201fa4201	Bala	IT	Tenali

   Sample Output

201fa4200	Raja	CSE	Guntur

9. Write a C program that reads content from an existing text file and write the same in a new file by changing all lowercase alphabetic character to upper case. (Existing file may contain digit and special characters).

   Example:

   Input: Enter the file name.

   Output: New file with updated content.

10. Write a C program to count the occurrences of the given string in a file.

    Example:

    Input: Enter the File name to read the string to be counted.

    Output: Display the count of occurrences of the string.

11. Write a C Program to transfer the data from one location to another location without changing the order of the content.

    Example:

    Read the file name from the user. If the source file exists, Transfer the data and display the message as “Data is transferred successfully” otherwise display the message “No such file is existing in the directory.”

12. Write a C program that reads numbers and write them into a text-file. Also find odd and even numbers in that file and store it in 2 separate files named odd.txt and even.txt. All the values should be in ascending order.

Input: Enter the values.
Output: Creates a separate file for Even and Odd numbers.
Sample Input:
4 43 2 53 45
Sample Output:
Even.txt: 2 4
Odd.txt: 43 45 53

13. Write a C program to replace the content in the given text file.
Input: Enter the file name, line number to be replaced and the new content
Output: New file with replaced lines.
Example:
Sample Input: Enter the file name: abc.txt
Enter the line no to replace: 3
Enter the content: Files stores data presently.
Sample Output:
Line no 3 is replaced with the given content.
The content of the file abc.txt contains:
test line 1
test line 2
Files stores data presently
test line 4

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
2	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
3	Select problem specific data structures and suitable accessing methods.	Analyze	1,2	1,2
4	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3
5	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Evaluate	1,2	3,4

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, “Programming for Problem Solving”, 1st edition, Cengage publications, 2019.
2. Ajay Mittal, “Programming in C - A Practical Approach”, 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, “Computer Fundamentals and Programming in C”, 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, “Programming with C”, 4th edition, Tata McGraw-Hill, 2018.

22EN102 ENGLISH PROFICIENCY AND COMMUNICATION SKILLS

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE:

Basics of grammar, Read and understand for global context, Cultural sensitivity and Basic writing skills.

COURSE DESCRIPTION AND OBJECTIVES:

English Proficiency and Communication Skills seeks to develop the students' abilities in grammar, speaking, reading, writing and overall comprehension skills. The course will provide students an exposure on a wide range of language use in everyday situations. It will make the students to equip with functional English and make them use it confidently in their professional and social contexts. Finally, students will strengthen their reading, writing, listening and speaking skills in English.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

MY LIFE AND HOME - MAKING CHOICES - HAVING FUN

Reading: Understanding main message, factual information global meaning, specific information and paraphrasing.

Writing: Developing hints based mail, Writing short messages/paragraphs.

Listening: Understanding short monologues or dialogues and choose the correct visual.

Speaking: Express simple opinions /cultural matters in a limited way.

Vocabulary: Discerning use of right word suiting the context, B1 Preliminary word list.

Grammar: Frequency Adverbs, State Verbs, AFV and Prepositions.

UNIT-2 **0L+0T+8P=8 Hours**

ON HOLIDAY - DIFFERENT FEELINGS - THAT'S ENTERTAINMENT!

Reading: Longer text for detailed comprehension, gist and inference.

Writing: Developing notes and responding to penfriends or 'e-pals'.

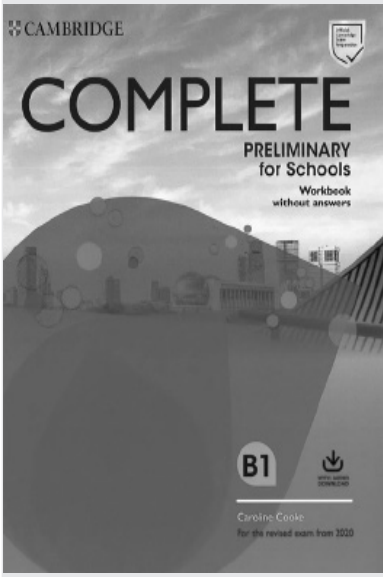
Listening: Understand straight forward instructions or public announcements.

Speaking: Describing people, things and places in a photograph.

Vocabulary/Grammar: Comparatives and Superlatives, Gradable and non-gradable adjectives, Cloze tests.

PRACTICES:

- Developing hints based mail.
- Writing short message.
- Writing paragraphs.
- Expressing opinions and cultural matters.
- Understanding short monologues.
- Understanding straight forward instructions and public announcements.
- Describing people, things and places in a photograph.



Source : https://www.gramedia.com/pendidikan/jurusan-bioentrepreneurship/

SKILLS:

- ✓ *Use of appropriate grammar and vocabulary with syntactic patterns in short texts.*
- ✓ *Read and extract the main message, global meaning, specific information, detailed comprehension, understanding of attitude, opinion and writer purpose and inference.*
- ✓ *Listen to understand key information, specific information, gist and detailed meaning and to interpret meaning.*
- ✓ *Understand questions and make appropriate responses and talk freely on everyday topics.*

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

GETTING AROUND – INFLUENCES - STAY FIT AND HEALTHY

Reading: Reading for understanding coherence of the text and drawing inferences.
Writing: Reading an announcement from a magazine or website for preparing an article.
Listening: Discussion activities and listening to understand the gist of each short dialogue.
Speaking: Snap Talks, Make and respond to suggestions, discuss alternatives and negotiate agreement.
Vocabulary / Grammar: Punctuation, Prepositions, Phrasal Verbs, B1 Preliminary word list.

UNIT-2 **0L+0T+8P=8 Hours**

LOOKS AMAZING! - THE NATURAL WORLD - EXPRESS YOURSELF!

Reading: Content, Communicative Achievement, Organisation and Language.

Writing: Developing a story with clear links to the given opening sentence.

Listening: An interview for a detailed understanding of meaning and to identify attitudes and opinions.

Speaking: Discuss likes, dislikes, experiences, opinions, habits, etc.

Vocabulary / Grammar: Modals, Conditionals, Verb forms (Time and Tense).

PRACTICES:

- Listening to understand the gist of each short dialogue.
- Listening to an interview for a detailed understanding of meaning and to identify attitudes and opinions.
- Preparing an article.
- Discuss for alternatives and negotiate agreement.
- Discussion on likes, dislikes, experiences, opinions, habits, etc.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply to read and grasp content on a range of topics/ texts related to their everyday life like notifications, advertisements, travel brochures, news reports, articles.	Apply	1	7, 8, 9, 10, 12
2	Apply suitable strategies to achieve comprehension, like listening for main points and checking comprehension using contextual clues etc.	Apply	1	7, 8, 9, 10, 12
3	Use functional English to communicate and interact effectively in everyday situations.	Apply	1, 2	7, 8, 9, 10, 12
4	Demonstrate vocabulary beyond that of the familiar subjects.	Analyze	1, 2	7, 8, 9, 10, 12
5	Show sufficient control of English grammar and sentence variety to coherently organise information at sentence and discourse levels.	Evaluate	2	7, 8, 9, 10, 12

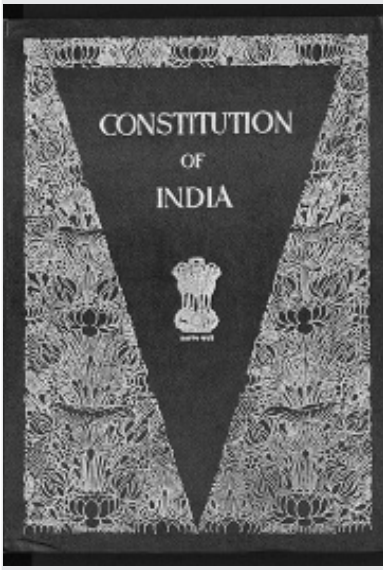
TEXT BOOK:

1. Emma Heyderman and Peter May, “Complete Preliminary”, Student’s Book. Answers, 2nd edition, Cambridge University Press, 2019.

REFERENCE BOOKS:

1. Annette Capel and Rosemary Nixon, “Introduction to PET”, 1st edition, Oxford University Press, 2009.
2. Adrian Doff and Craig Thaine, Empower Pre intermediate, 2nd edition, Cambridge University Press, 2015.
3. Louise Hashemi and Barbara Thomas, Objective PET, 1st edition, Cambridge University Press, 2010.

22TP101 CONSTITUTION OF INDIA



Source : https://commons.wikimedia.org/wiki/File:Constitution_india.jpg

Hours Per Week :

L	T	P	C
0	2	0	1

PREREQUISITE KNOWLEDGE:

High School-level Civics and Social Studies.

COURSE DESCRIPTION AND OBJECTIVES:

To provide students with a basic understanding of Indian Polity and Constitution and make students understand the functioning of government at the center and state level besides local self-government. This course also equips students with knowledge pertaining to fundamental rights and fundamental duties of a citizen in a democracy such as India.

MODULE-1

UNIT-1 **0L+8T+0P=8 H**

HISTORICAL BACKGROUND TO THE INDIAN CONSTITUTION

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India.

UNIT-2 **0L+8T+0P=8 H**

FUNDAMENTAL RIGHTS, DUTIES, DIRECTIVE PRINCIPLES, AND AMENDMENT

Scheme of the fundamental rights - scheme of the Fundamental Right to Equality, scheme of the Fundamental Right to certain Freedom under Article 19, scope of the Right to Life and Personal Liberty under Article 21, Scheme of the Fundamental Duties and its legal status, Directive Principles of State Policy – its importance and implementation, Amendment of the Constitution - Powers and Procedure.

PRACTICES:

- Enactment of Constituent Assembly debates to further understand the rationale for the provisions of the constitution.
- Fundamental Rights in our popular culture - discussion in the movie Jai Bhim.

MODULE-2

UNIT-1 **0L+8T+0P=8 H**

STRUCTURE AND FORM OF GOVERNMENT

Federal structure and distribution of legislative and financial powers between the Union and the States; Parliamentary Form of Government in India – The constitution powers and status of the President of India; Emergency Provisions: National Emergency, President Rule, Financial Emergency.

UNIT-2 **0L+8T+0P=8 H**

LOCAL SELF GOVERNMENT

Local Self Government – Constitutional Scheme in India – 73rd and 74th Amendments.

SKILLS:

- ✓ *Understanding the basics of the Indian constitution.*
- ✓ *Know the fundamental rights, fundamental duties, and Directive Principles of State Policy.*
- ✓ *Fair knowledge about the functioning of various institutions in a democracy.*

PRACTICES:

- Debate on federalism in India.
- Collect news published in the local papers about panchayats in the nearby areas.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse major articles and provisions of the Indian constitution.	Analyze	1	6
2	Appreciation for the constitution and safeguarding individual rights.	Apply	1	6
3	Evaluating functions of various organs of the State in a democracy.	Evaluate	2	6

TEXTBOOKS:

1. PM Bhakshi, “Constitution of India”, 15th edition, Universal Law Publishing, 2018.

REFERENCE BOOKS:

1. B. R. Ambedkar, “The Constitution of India”, 2020 edition, Educreation Publishing, India, 2020.
2. Subhash Kashyap, “Our Constitution”, 2nd edition, National Book Trust, India, 2011.
3. Arun K. Thiruvengadam, “The Constitution of India: A Contextual Analysis”, 1st edition, Hart Publishing India, 2017.

22MT110 MATRICES AND DIFFERENTIAL EQUATIONS

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE:

School level Mathematics, Differentiation and Integration

COURSE DESCRIPTION AND OBJECTIVES:

This course will help the students to learn the concepts of matrices and differential equations. Also they can apply these concepts in any engineering and science domains.

MODULE-1

UNIT -1 **12L+8T+0P=20 Hours**

MATRICES

Definition of matrix; Types of matrices, Algebra of matrices, adjoint of a matrix, inverse of a matrix by elementary operations, Rank of a matrix, Echelon form, Normal form.

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF MATRICES

Consistency of system of linear equations, Solution of system of linear equations by Gauss elimination method and Gauss Jordan method.

Eigen values and Eigen vectors (up to 3 x 3 matrices only) and properties (without proofs).

PRACTICES:

- Identify the matrix and do various operations on it.
- Finding rank of matrix.
- Solving a system of equation using matrix method
- Find Eigen values and Eigen vectors.

MODULE-2

UNIT-1 **12L+8T+0P=20 Hours**

ORDINARY DIFFERENTIAL EQUATIONS

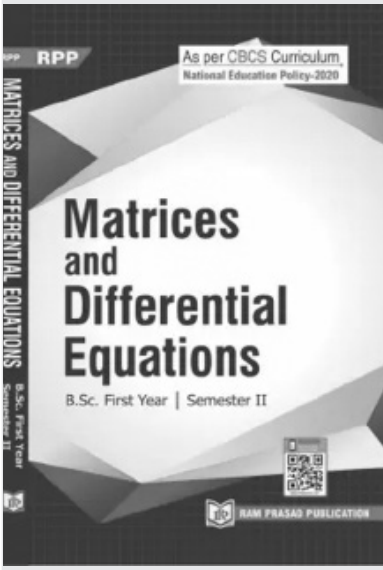
First Order Differential Equations: Introduction to ODE, variable separable method, homogenous and non-homogenous differential equations, linear differential equations, Bernoulli's equations.

Second Order Differential Equations: Linear Homogeneous and non-homogeneous differential equations with constant coefficients (RHS is eax, xn, sin(ax) or cos(ax)).

UNIT-2 **12L+8T+0P=20 Hours**

APPLICATIONS OF ODE

Applications of ODE: Newton's law of cooling, Law of natural growth and decay, LC circuit.



Source:https://www.flipkart.com/matrices-differential-equations-nep-b-sc-sem-ii/p/itmefb5ea2219421

PRACTICES:

- Finding Solutions of Differential Equations.
- Apply the concepts of Differential equations.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply elementary transformations to find the rank and inverse.	Apply	1	1, 2, 9, 10, 12
2	Solve the Ordinary differential equations.	Apply	2	1, 2, 9, 10, 12
3	Apply the differential equation in various problems.	Apply	2	1, 2, 9, 10, 12
4	Examine the consistency of the system of linear equations.	Analyse	1	1, 2, 9, 10, 12

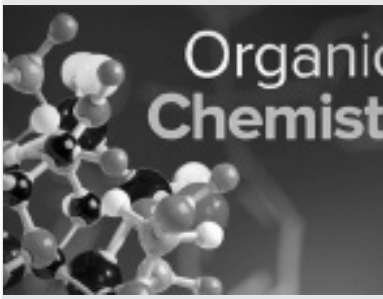
TEXT BOOKS:

1. N. P. Bali, K. L. Sai Prasad, “A Textbook of Engineering Mathematics I, II, III”, 2nd Edition, Universal Science Press, New Delhi, 2018.
2. B. S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, 2018.

REFERENCE BOOKS:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, Inc., 2015
2. H. K. Dass and Er. Rajanish Verma, “Higher Engineering Mathematics”, 3rd Edition, S. Chand & Co., 2015.
3. B. V. Ramana, “Advanced Engineering Mathematics”, 2nd Edition, TMH Publishers, 2020.

22CT104 ORGANIC CHEMISTRY



source: https://grasptutorials.com/subjects/jee.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Intermediate level knowledge of chemistry

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamental concepts of organic chemistry which will help to design and synthesize organic compounds and understand their properties. This course will make the student familiar with basic concepts of bonding, reaction intermediates and stereochemical aspects applicable in synthetic organic chemistry and organic materials. As a first-level course for B. Tech. students with biology background, it will be a strong basis to understand advanced level mechanistic aspects of biochemical reactions and also synthesis of organic molecules with medicinal value.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

CHEMICAL BONDING AND REACTION INTERMEDIATES

Chemical Bonding: Introduction to VBT and VSEPR theory, Molecular Orbital (MO) energy diagram of Ethylene, 1,3-Butadiene.

Reaction Intermediates: Bond fissions and arrow-pushing, formation, and reactivity of carbanions, carbocations, free radicals, carbenes.

UNIT-2 **10L+0T+10P=20 Hours**

STEREOCHEMISTRY

Representations of 3 Dimensional structures, Structural isomers and Stereoisomers, Chirality, optical isomerism - Enantiomers and Diastereomers (Lactic acid and Tartaric acid), Absolute configurations (R/S), Conformational analysis – Ethane.

PRACTICES:

- Comparison MO diagrams of 1,3,5 hexatriene and Benzene.
- Determination of melting point and boiling point of organic compounds.
- Separation of organic compounds by thin layer chromatography(TLC).
- Drawing of chemical structures (Vitamin A, B1, C, D/Amino acids/Sugars/Carbohydrates/ Flavonoids/Terpenoids).
- Analysis of functional groups.
- Carboxylic acids.
- Carbonyl compounds.
- Amines.
- Construction of organic molecules (Tartaric acid (meso, RR and SS) using ball stick models.
- Relevance of stereochemistry in biology eg. Thalidomide.
- Stability of carbocation by rearrangement.

SKILLS:

- ✓ *Design a scheme for an organic reaction.*
- ✓ *Identify the stereochemical feature of a molecules based on the structure.*
- ✓ *Apply the R&D scale to Gram scale reaction.*
- ✓ *Choose the desired green solvent required for a reaction.*
- ✓ *Analyse the desired product, side product and impurities formed during the course of the reaction pathway.*

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

ORGANIC REACTIONS AND GREEN CHEMISTRY

Organic reactions: Introduction to reactions involving substitution (SN1 vs SN2), addition (Electrophilic and Nucleophilic), Elimination (E1 and E2), Oxidation (Jones reagent) and reduction (LiAlH4).

Green chemistry 12 Principles of Green chemistry and introduction to catalysis with example.

UNIT-2 **10L+0T+10P=20 Hours**

STRUCTURAL ELUCIDATION OF ORGANIC COMPOUNDS

IR Spectroscopy: Introduction, principle, identification of functional groups.

NMR spectroscopy: Introduction, principle, chemical shift, 1H-NMR (Ethyl alcohol and other simple molecules), cis-trans isomers (J values).

Mass spectroscopy: Introduction, principle, fragmentation (nitrogen rule), Radioisotopes in biology.

PRACTICES:

- Preparation and characterization of Aspirin.
- Paper Chromatography for Identification of Amino acids from the mixture.
- Reduction of Nitro group to amino group using metal catalysis and characterization by IR and NMR
- Characterisation (IR) of functional groups.
  Carboxylic acids.
  Carbonyl compounds.
  Amines.
- Oxidation and of an Organic compound using Potassium Permanganate (KMnO4).
- Reduction and of Aldehydes using Sodium Borohydride (NaBH4).
- Preparation and characterization of Paracetamol using IR.
- Synthesis of BINOL using solvent free methods.
- Qualitative analysis of Phytochemicals.
  Alkaloid.
  Flavonoids.
- Synthesis and characterisation of Friedel-Craft acylation and alkylation product using β-naphthol.
- Demonstration of C-C bond formation reaction using L-Proline catalyst.

COURSEOUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the theories of bonding to predict the formation and reactivity of different reaction intermediates in organic reactions.	Apply	1	1, 2, 9, 10, 11, 12
2	Identify the stereochemical features of organic molecules and their the importance of chirality with relevance to biological activity.	Analyse	1,	1, 2, 6, 9, 10, 11, 12
3	Analyse various synthetic reactions for preparation of drug molecules by implementing the concept of Green Chemistry.	Analyse	1, 2	1, 2, 6, 7, 9, 10, 11, 12
4	Verify the structure of organic compound using the principles of instrumental techniques for structure determination.	Evaluate	2	1, 2, 4, 5, 9, 10, 11,12

TEXT BOOKS:

1. A. Bahl and B.S. Bahl, “Text Book to Organic Chemistry”, S.Chand & Co, 8th Edition, 2009.
2. R.T. Morrison, R.M. Boyd and S.K. Bhattacharjee, “Organic Chemistry”, Pearson Publications, 7th Edition, 2018.

REFERENCE BOOKS:

1. I. L. Finar, “Organic Chemistry”, Vol. 1, Longman Scientific Publications, 6th Edition,2006.
2. P. Bruice, “Organic Chemistry”, Pearson Scientific Publications, 8th Edition, 2020.
3. R. M. Silverstein, G. Bassler, M. Clayton, C.Terence, “Spectroscopic Identification of Organic Compounds”, Wiley-VCH, 8th Edition, 2014.
4. J. Mendham, R. C. Denney, J.D. Bares, M. Thomas, B. Siva Sankar, “Vogel’s Text Book of Qualitative Chemical Analysis”, Pearson Publications - Volume I, 2009.
5. D.L. Pavia, G.M. Lampman, G.S. Kriz, R.G. Engel, “A microscale approach to Organic Laboratory Techniques”, Cengage Learning Brooks/Cole Cengage, 5th Edition, 2012.

Source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

22TP104 BASIC CODING COMPETENCY

Hours Per Week :

L	T	P	C
0	1	3	2

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed to impart knowledge on advanced concepts of C programming language and problem solving. At the end of this course, students will be able to design, implement, test and debug complex problems using features of C.

MODULE-1

UNIT-1 **0L+4T+12P=16 Hours**

NUMBER CRUNCHING

PRACTICES:

Problems On Number Crunching

- Write a program to check if a given number is perfect or not.
- Write a program to check if a given number is deficient or not.
- Write a program to check if 2 given numbers are amicable or not.
- Write a program to check if 2 given numbers are betrothed or not.
- Write a program to check whether a given number is an Armstrong number or not.
- Write a program to print the series of prime numbers in the given range.
- Write a program to print all the perfect numbers in a given range.
- Write a program to generate all deficient numbers in a given range.
- Write a program to generate all the amicable numbers in a given range.
- Write a program to generate all the betrothed numbers in a given range.
- Write a program to find the largest prime factor of a given number.
- Write a program to check whether the given number is a palindrome or not.
- Write a program to calculate sum of the individual digits for the given number.
- Write a program to find the first number that has more than ‘n’ factors, excluding 1 and that number.
- Write a program to accept a number as input and print its factorial.
- Write a program to accept a number n, print first N Fibonacci numbers.
- Write a program to check if an input number is Armstrong number or not.
- Write a program that takes input a,b. Print a power b.
- Write a program that takes input a number n, check if it a perfect square or not.
- Print array in spiral format.
- Print sum of each row in a matrix.
- Print sum of each column in matrix.
- Print left->right and right->left diagonals in a matrix.
- Initially you are at (0,0) find the shortest path count to reach the (n, n) block in matrix.
- Remove all the elements present in row and column of unsafe elements. An element is called unsafe if it is equal to smallest or largest value. Count number of remaining elements.
- Write a program to check if the string contains all the letters of alphabet.
- Check if a string is matching password requirements.

- Check if String A contains String B (String searching).
- Check if a number is harshad number or not.
- Write a program to get 3 numbers as input. The first is the number num1 and second is the digit that needs to be replaced. The third is the digit that is to replace the 2nd digit. Print the number after performing this operation.
- Write a program to accept a number and swap its alternate digits. Print the number generated.
- Write a program to accept a number and choice as input. If the choice is 0 rearrange the number such that the odd digits are ordered first followed by the even digits. If the choice is 1 rearrange the number such that the even digits are ordered first followed by the odd digits. Print the rearranged number. The order of occurrence of the digits is to be preserved.
- Write a program to determine that whether the given quadrilateral is cyclic or not. You are given the sizes of angles of a simple quadrilateral (in degrees) A, B, C and D, in some order along its perimeter.

  Note: A quadrilateral is cyclic if and only if the sum of opposite angles is 180∘.
- Chef is a very lazy person. Whatever work is supposed to be finished in x units of time, he finishes it in m∗x units of time. But there is always a limit to laziness, so he delays the work by at max d units of time. Given x,m,d, find the maximum time taken by Chef to complete the work.
- Suppose Chef is stuck on an island and currently he has x units of food supply and y units of water supply in total that he could collect from the island. He needs xr units of food supply and yr units of water supply per day at the minimal to have sufficient energy to build a boat from the woods and also to live for another day. Assuming it takes exactly D days to build the boat and reach the shore, tell whether Chef has the sufficient amount of supplies to be able to reach the shore by building the boat? Read five integers x,y,xr,yr,D from the user and display “YES” if Chef can reach the shore by building the boat and “NO” if not (without quotes).
- There are 3 problems in a contest namely A,B,C respectively. Alice bets Bob that problem C is the hardest while Bob says that problem B will be the hardest.

You are given three integers SA,SB,SC which denotes the number of successful submissions of the problems A,B,C respectively. It is guaranteed that each problem has a different number of submissions. Determine who wins the bet.

1) If Alice wins the bet (i.e. problem C is the hardest), then output Alice.
2) If Bob wins the bet (i.e. problem B is the hardest), then output Bob.
3) If no one wins the bet (i.e. problem A is the hardest), then output Draw.

   Note: The hardest problem is the problem with the least number of successful submissions.

   Input Format

- The first line of input contains a single integer T denoting the number of test cases. The description of T test cases follows.
- The first and only line of each test case contains three space-separated integers SA,SB,SC, denoting the number of successful submissions of problems A,B,C respectively.

  Output Format

  For each test case, output the winner of the bet or print Draw in case no one wins the bet.

  Sample Input 1

  3

  1 4 2

  16 8 10

  14 15 9

  Sample Output 1

  Draw

  Bob

  Alice

SKILLS:

- ✓ *Analysis of the problem to be solved.*
- ✓ *Application of various file operations effectively in solving real world problems.*
- ✓ *Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.*

- In a season, each player has three statistics: runs, wickets, and catches. Given the season stats of two players A and B, denoted by R, W, and C respectively, the person who is better than the other in the most statistics is regarded as the better overall player. Tell who is better amongst A and B. It is known that in each statistic, the players have different values.

  Input

  The first line contains an integer T, the number of test cases. Then the test cases follow.

  Each test case contains two lines of input.

  The first line contains three integers R1, W1, C1, the stats for player A.

  The second line contains three integers R2, W2, C2, the stats for player B.

  Output

  For each test case, output in a single line "A" (without quotes) if player A is better than player B and "B" (without quotes) otherwise.

- Write a program to find the direction.

  Chef is currently facing the north direction. Each second he rotates exactly 90 degrees in clockwise direction. Find the direction in which Chef is facing after exactly X seconds.

  Note: There are only 4 directions: North, East, South, West (in clockwise order). Initially chef is at 0th second i.e., facing North direction.

  Input Format

- First line will contain T, number of testcases. Then the testcases follow.
- Each testcase contains of a single integer X.

  Output Format

  For each testcase, output the direction in which Chef is facing after exactly X seconds.

  Sample Input 1

  3

  1

  3

  6

  Sample Output 1

  East

  West

  South

- Chef is playing in a T20 cricket match. In a match, Team A plays for 20 overs. In a single over, the team gets to play 6 times, and in each of these 6 tries, they can score a maximum of 6 runs. After Team A's 20 overs are finished, Team B similarly plays for 20 overs and tries to get a higher total score than the first team. The team with the higher total score at the end wins the match.
- Chef is in Team B. Team A has already played their 20 overs, and have gotten a score of R. Chef's Team B has started playing, and have already scored C runs in the first O overs. In the remaining 20−O overs, find whether it is possible for Chef's Team B to get a score high enough to win the game. That is, can their final score be strictly larger than R?

  Input: There is a single line of input, with three integers, R, O, C.

  Output: Output in a single line, the answer, which should be "YES" if it's possible for Chef's Team B to win the match and "NO" if not.

- Make Array Zeros using pointers

  You are given an array A of length N (size should be created using Dynamic memory allocation) and can perform the following operation on the array:

  Select a subarray from array A having the same value of elements and decrease the value of all the elements in that subarray by any positive integer x.

  Find the least possible number of operations required to make all the elements of array A equal to zero.

  The first line contains an integer N denoting the number of elements in the array.

The next line contains space-separated integers denoting the elements of array A.

Print the least possible number of operations required to make all the elements of array A equal to zero.

Sample Test case

Input:

5

2 2 1 3 1

Output:

4

UNIT-2 **0L+4T+12P=16 Hours**

PATTERNS

PRACTICES:

- Problems on Number Patterns
- Write a program to generate Floyd triangle. Sample input N= 4.

  1

  2 3

  4 5 6

  7 8 9 10
- Write a program to generate the following pattern. Sample input N=5.

  13579

  3579

  579

  79

  9
- Write a program to generate the following pattern. Sample input N=4.

  1111111

  222222

  33333

  4444

  333

  22

  1
- Write a program to generate the following pattern. Sample input N=5.

  5432*

  543*1

  54*21

  5*321

  *4321
- Write a program to generate the following pattern. Sample input N=5.

  12 21

  123 321

  1234 4321

  123454321

- Write a program to generate the following pattern. Sample input N=5.
  1
  2*2
  3*3*3
  4*4*4*4
  4*4*4*4
  3*3*3
  2*2
  1
- Write a program to generate the following pattern. Sample input N=4.
  1
  212
  32123
  4321234
- Write a program to generate the following pattern. Sample input N=5.
  *
  * *
  * * * *
  * *
  *
- Write a program to print Pascal triangle for the given number of rows. Sample input N=5.

```
          1
        1   1
      1   2   1
    1   3   3   1
  1   4   6   4   1
```

- Write a program to generate the following pattern. Sample input N=4.
  1234
  2341
  3421
  4321
- Print Hollow Diamond pattern.
- Print pascals triangle.
- Print Floyds triangle.
- Print Butterfly Pattern.
- Print palindromic pattern.
- Print full inverted number triangle.
- Check if a number is prime or not (Efficient Approach).
- Find sum of all the digits of the number.
- Print transpose of given matrix.
- Rotate a two dimensional matrix by 90, 180, 270 degrees.

MODULE-2

UNIT-1 **0L+4T+12P=16 Hours**

ARRAYS

PRACTICES: Problems On Arrays

Given an unsorted array of size N, and the array elements are in the range of 1 to N. There are no

duplicates, and the array is not sorted. One of the integers is missing. Write a program to find the missing number.

Given an array consisting of only 0s and 1s in random order rearrange the array such that all the 0s are to the left of the array and 1s to the right.

Give an array consisting of odd and even numbers in random order, rearrange the array such that all the odd numbers are to the left of the array and even numbers are to the right of the array.

- Write a program to find all the unique elements in an array.
- Write a program to merge two arrays of the same size sorted in descending order.
- Write a program to count the frequency of each element in an array of integers.
- Write a program to find the second largest element in an array.
- Write a program to find the second smallest element in an array.
- Write a program to find that one element in array that occurs odd number of times, where every other element appears even number of times.
- Create a jagged array (adjacency list representation of a graph) with no of rows and no of columns in each row as specified by the user.

  Hint: Use Dynamic memory allocation (malloc() or calloc())

  Input:

  Enter no of rows: 3

  Enter no of columns Row in 1: 3

  Enter no of columns Row in 2: 5

  Enter no of columns Row in 3: 2

  Enter the elements row wise:

  8 6 5

  8 4 6 9 7

  9 2

  Output:

  8 6 5

  8 4 6 9 7

  9 2
- Write a program to find second largest number in the array.
- Write a program to find first repeating element in the array.
- Write a program to left rotate the array.
- Write a program to right rotate the array.
- Write a program to find the largest continuous sum.
- Write a program to print the sum of 2nd largest and 2nd smallest elements.
- Write a program to find the maximum product of two numbers multiplies in array (same index should not be used twice).
- Rearrange an array consisting of 1s and 0s such that they are alternatively arranged. Print minimum number of moves required.
- In a given array, find two numbers whose sum equal k.
- Find the difference between positive and negative elements in the array.
- Implement sorting algorithms (Insertion, selection, bubble).

UNIT-2 **0L+4T+12P=16 Hours**

STRINGS

PRACTICES: Problems on Strings:

- Write a program to reverse a given string word by word.
- Write a program to find the first occurrence of non-repeating character in the given string.

- Write a program to compress the string as provided in the example.
- Write a program to expand a string as provided in the example.
- Write a program to reverse those words of a string whose length is odd.
- Write a program to check if a given matrix is symmetric or not.
- Write a program to convert all the cases of letter (Lower case -> Upper Case, Upper Case-> Lower Case).
- Write a program to reverse all the words (Not the entire sentence but individual words).
- Find the longest palindrome in a given string.
- Check if two strings are anagrams or not.
- Find minimum number of changes to be done to make a string palindrome.
- Convert Excel sheet name to number (A-1, B-2, Z-26, AA-27).
- Find number of possible palindromes present in a string.
- Write a C program to read a string s, and determine the number of words in s.
  Example : s=oneTwoThree

  There are 3 words in the string: 'one', 'Two', 'Three'.
- Write a C program that reads a string S and remove all duplicates characters from the given string S.
  NOTE: 1) Order of characters in output string should be same as given in input string.

  2) String S contains only lowercase characters ['a'-'z'].

  Example: S = Vignan University

  The program should generate the output as: Spelling
- Today Ron is reading the book. Due to some reason, he started hating the word 'are' (without quotes). So he decided to replace the substring 'are' with 'R'. Write a C program that reads a line of message 's' and replace the substring 'are' with 'R'. Example: s= Howareyou.
- The program should generate the output as: HowRyou
- Write a program to concatenate the characters of the two given strings alternatively.
- Given a string S consisting of uppercase and lowercase letters, change the case of each alphabet in this string. That is, all the uppercase letters should be converted to lowercase and all the lowercase letters should be converted to uppercase.
  Input: Vignan university

  Output: vIGNAN uNIVERSITY
- Write a program to insert a given character at the beginning and end of the given string.
- Given two Strings A and B. They are said to be friends if ASCII sum of the each individual string is divisible by 4 else they are not friends. You need to find whether given two strings are friends or not.
  Sample Test case:

  Input:

  man nam

  vignan university

  Output:

  YES

  NO
- Write a program to find the frequency of each digit in the given string.
  Input Format

  The first line contains a string, which is the given number.

Output Format

Print ten space-separated integers in a single line denoting the frequency of each digit, indicate that the integers are from 0 to 9.

Sample Input 0

a11472o5t6

Sample Output 0

0 2 1 0 1 1 1 1 0 0

Explanation 0

In the given string:

- 1 occurs two times.
- 2,4,5,6 and 7 occur one time each.
- The remaining digits and don't occur at all.
- Sherlock considers a string to be valid if all characters in the given string appear the same number of times. It is also valid if he can remove just 1 character at 1 index in the string, and the remaining characters will occur the same number of times.

  Write a C program that reads a string s and determine whether it is valid or not. If valid, return YES, otherwise return NO.

  Example: S=abc

  This is a valid string because frequencies are {a:1,b:1,c:1}

  S=abcc

  This is a valid string because we can remove one c and have 1 of each character in the remaining string.

  S=abccc

  This string is not valid as we can only remove 1 occurrence of c. That leaves character frequencies of {a:1,b:1,c:2}
- Read a string containing characters A and B only. Your task is to change it into a string such that there are no matching adjacent characters. To do this, you are allowed to delete zero or more characters in the string.

  Write a C program that finds the minimum number of deletions required.

  Example: S=AABAAB

  Remove A at positions 0 and 3 to make S=ABABA in 2 deletions.

  Input Format

  The first line contains an integer (the number of queries).

  The next q lines each contain a string s to analyze.

  Sample Input:

  5

  AAAA

  BBBBB

  ABABABAB

  BABABA

  AAABBB

Sample Output:

3

4

0

0

4

- Write a C program that reads a string ‘s’ and it is said to be complete if it contains all the characters from a to z.

  Input Format

  First line of the input contains the number of strings N. It is followed by N lines each contains a single string.

  Output Format

  For each test case print “YES” if the string is complete, else print “NO”

  Constraints 1 <= N <= 10

  The length of the string is at max 100 & the string contains only the characters a to z.

- Write a C program that reads two strings and determine whether they share a common substring or not. A substring may be as small as one character.

  Example;

  S1=and

  S2=art

  The common substring in these two strings: a.

  Sample Input

  2

  hello

  world

  hi

  world

  Sample Output

  YES

  NO

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Write simple, but complete, C programs.	Apply	1,2	1
2	Identify suitable data type for operands and design of expressions having right precedence.	Apply	1,2	1
3	Apply decision making and iterative features of C Programming language effectively.	Apply	1,2	1
4	Select problem specific data structures and suitable accessing methods.	Analyse	1,2	1,2
5	Design and develop non- recursive and recursive functions and their usage to build large modular programs and also able to design string manipulation functions.	Create	1,2	3
6	Develop C programs that are understandable, debuggable, maintainable and more likely to work correctly in the first attempt.	Create	1,2	3,4

TEXT BOOKS:

1. Behrouz A. Forouzan, Richard F.Gilberg, “Programming for Problem Solving”, 1st edition, Cengage publications, 2019.
2. Ajay Mittal, “Programming in C - A Practical Approach”, 1st edition, Pearson Education, India, 2010.

REFERENCE BOOKS:

1. Reema Thareja, “Computer Fundamentals and Programming in C”, 1st edition, Oxford University Press, India, 2013.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, Tata McGraw-Hill, 2017.
3. Byron S Gottfried, “Programming with C”, 4th edition, Tata McGraw-Hill, 2018.

source:https://depositphotos.com/5087383/stock-photo-the-engineering-drawing.html
Image file name: Engineering Graphics

22ME101 ENGINEERING GRAPHICS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Geometry.

COURSE DESCRIPTION AND OBJECTIVES:

Engineering graphics is the language of engineers and is the most effective way of communicating and sharing technical ideas in the form of pictures/drawings. The objective of this course is to familiarize the students with the conventional concepts of engineering drawing and computer aided drawing.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

ENGINEERING CURVES

Types of lines; Lettering, Dimensioning, Geometric constructions - lines, polygons (Angle, ARC, General and Inscribe in circle method), Conical curves (General method), Ellipse by Oblong method.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC PROJECTIONS OF POINTS, LINES & PLANES

Principles of projection, Projections of points, Projection of straight lines - Inclined to one plane, inclined to both planes, Projection of planes - Inclined to one plane.

PRACTICES:

- Construction of polygons using different methods (i.e. ARC, Angle, General).
- Inscribe a regular hexagon & pentagon in a circle of the given diameter.
- Tracing of conical curves (Ellipse, Parabola, Hyperbola) by using General Method.
- Draw the projections of the points situated in all the 4 quadrants.
- Draw the projections of a line when it is inclined to one plane (HP or VP).
- Draw the projections of a line when it is inclined to both the planes (HP &VP).
- Draw the projections of a plane when it is inclined to one plane (HP or VP).

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

PROJECTIONS OF SOLIDS: Projection of solids axis inclined to one reference plane - Prisms, pyramids, Cylinder and cone.

DEVELOPMENT OF SURFACES: Development of lateral surfaces of simple solids - Prisms, Pyramids, Cylinder and cone.

UNIT-2 **10L+0T+10P=20 Hours**

ORTHOGRAPHIC VIEWS: Conversion of pictorial views into orthographic views.

DRAFTING USING COMPUTER PACKAGE: Introduction to 2D modelling software - AutoCAD, Conversion of Isometric view into Orthographic views of simple castings, Conversion of Orthographic views into Isometric view of simple solids - Prisms, Pyramids, Cylinders and cones

PRACTICES:

- Draw the projections of Prisms, when they are inclined to one reference plane (HP or VP)
- Draw the projections of Pyramids, when they are inclined to one reference plane (HP or VP)
- Draw the projections of cylinder & cone, when they are inclined to one reference plane (HP or VP)
- Draw the complete surface development of prisms&pyramids with the given dimensions
- Draw the complete surface development of cylinder & cone with the given dimensions
- Draw the orthographic view's (i. e. front view, top view, and side view) of the given pictorial view of the sketches by using AutoCAD
- Draw the Isometric view of simple solids (Prisms & Pyramids) by using AutoCAD
- Draw the Isometric view of simple solids (Cylinder & Cone) by using AutoCAD.

SKILLS:

- ✓ *Convert iso-metric views of objects into orthographic views and vice versa*
- ✓ *Visualize the shape of the 3D components*
- ✓ *Create pictorial views by using AutoCAD*
- ✓ *Understand projections by visualization.*

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

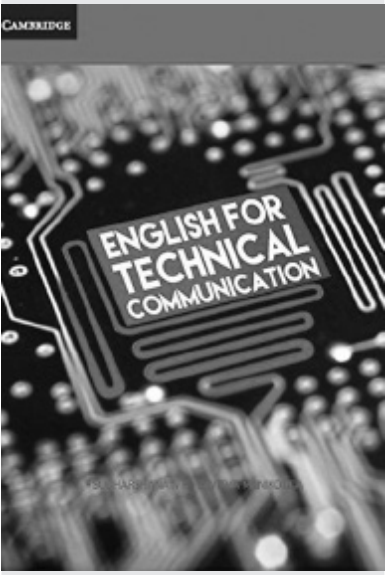
CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Communicate the technical ideas in the form of drawings.	Apply	1	1,2,3,5
2	Apply the drawing skills in representing various geometrical features.	Apply	1	1,2,3,5
3	Develop orthographic projections and isometric views of various objects.	Apply	1	1,2,3,5
4	Estimate the lateral surface area of regular geo-metrical solids.	Analyze	2	1,2,3,5
5	Sketch simple objects and their pictorial views using AutoCAD.	Analyze	2	1,2,3,5

TEXT BOOKS:

1. J Hole, "Engineering Drawing", 2nd edition, Tata McGraw-Hill, 2019.
2. N D Bhatt, "Engineering Drawing", 53rd edition, Charotar Publication, 2014

REFERENCE BOOKS:

1. Basant Agrawal and C.M. Agrawal "Engineering Drawing", 2nd edition, Tata Mc Graw- Hill, 2018.
2. K L Narayana, "Engineering drawing", 3rd edition, SciTech Publications, 2011.
3. Colin H. Simmons, Dennis E. Maguire, Manual of Engineering Drawing, 2nd edition, 2003.



source: https://www.abebooks.com/9781316640081/English-Technical-Communication-Students-Book-1316640086/plp

22EN104 TECHNICAL ENGLISH COMMUNICATION

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basic sentence formation, understanding contextual meanings, basic writing skills and moderate fluency in English.

COURSE DESCRIPTION AND OBJECTIVES:

In this course students will read, analyze, and interpret material from technical and general fields, and practice reading, writing, listening and speaking skills to gain exposure and functional English on a variety of contemporary topics. The overall course objective is to provide English for Specific Purposes(ESP) instruction to enhance students' reading, writing, listening and speaking skills through a practice in the language. It will aim to build students' confidence and motivation through exposure to academic skills like Note making/taking, Paraphrasing, Summarizing, Report Writing, Making Presentations etc., so as to generate interest in the language from an ESP perspective. Finally, students are expected through the course to gain key strategies and expression for communicating with professionals and non-specialists.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

GENETICS

Reading: Reading for Note Making Sub skills, Reading for global understanding (skimming), specific information (scanning), understanding main ideas and supporting ideas, guessing contextual meanings from the text. -Vocabulary building: commonly used roots, prefixes, and suffixes.

Writing: Note making, organising main points and sub points, numbering and sequencing, suggesting titles, paraphrasing and summarising.

Functional grammar: Common Errors in Articles and Prepositions (Handout).

Listening: Listening for Note Taking, top down and bottom up approach, listening for main ideas and supporting points.

Speaking : Presentation in teams - ideas on the topic summarised, making a PPT, effective introductions and conclusions, logical organisation of content, using appropriate structure and cohesive devices.

UNIT-2 **8L+0T+8P=16 Hours**

ALIENS

Reading : Reading: predicting, skimming, scanning, reading for inference, extrapolative reading.

Vocabulary building: Academic vocabulary from the text: synonyms, antonyms, Words often confused.

Writing : Paragraph writing; writing a topic sentence, supporting sentences, effective introductions and conclusions, use of cohesive devices. Types of Paragraphs: Descriptive, narrative, argumentative and expository.

Functional grammar: Common Errors in Verb forms and Conditional sentences (Handout).

Listening: Listening for identifying parts from a description, listening to and sorting information, listening for specific information.

Speaking: Narrating/Retelling an incident,using suitable cohesive devices/discourse markers Speaking of past and present habits/ activities/events - Speaking of future plans.

PRACTICES:

- Note making.
- Summarizing.
- Paragraph Writing.
- Error correction and Restructuring.
- Vocabulary building.
- Listening comprehension.
- Note taking.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

SOCIAL MEDIA – HEALTH AND NUTRITION

Reading: Reading for factual information researching for supporting evidence - skimming, scanning, Vocabulary building: One-word substitutes.

Writing: Letter Writing- E-mail writing – New age communication – Format, protocol, and style- WhatsApp, Facebook and Twitter Functional grammar:Common Errors in Sub-Verb Agreement and Modals.

Listening: Listening to a Business Presentation: Listening for deducing information, for abstract details and specific details, listening for taking a message.

Speaking: Making a presentation with a PPT on a topic assigned- organising the presentation using appropriate discourse markers - presenting a point of view - Extempore.

UNIT-2 **8L+0T+8P=16 Hours**

FASHION

Reading: Reading for data interpretation and information transfer from graphical aids to text reports (pictograms. tables, graphs, pie charts, flow charts), deducing specific information and general information

Vocabulary building: business vocabulary, collocations, idioms and phrasal verbs.

Writing: Writing a Report:Drafting general and factual reports - writing an overview - an effective introduction - organising information into paragraphs (Stages of writing: planning /organising /writing / editing /rewriting)

Functional grammar:transformations and miscellaneous common errors.

Listening : Listening to a Ted talk and sorting information – taking notes from a discussion.

Speaking: Group Discussion – prerequisites -generating content - initiating a discussion - expressing one's opinion ~ leading a discussion - agreeing/ disagreeing to someone's view - cutting into a speech - body language and voice modulation.

PRACTICES:

- E-mail writing.
- Letter writing.
- Report writing.
- Messaging in Social media.
- Extempore.
- Making PPTs.

SKILLS:

- ✓ *Apply different subskills like skimming, scanning, reading for information, reading for inference etc. to understand different kinds of text.*
- ✓ *Apply different sub skills like top down, bottom up approaches to listening.*
- ✓ *Use functional vocabulary relevant to engineering and technology to express ideas lucidly.*
- ✓ *Use appropriate sentence structure, cohesive devices to construct simple text in regular correspondence like e-mails and letters.*

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply a variety of strategies to interpret and comprehend spoken texts/ discourse using contextual clues.	Apply	1	6, 7, 8, 9, 10, 12
2	Apply appropriatereading strategies to interpret content / material related to engineering and technology domain.	Apply	1	6, 7, 8, 9, 10, 12
3	Participate in discussions and make short presentations on general and technical topics.	Apply	1, 2	6, 7, 8, 9, 10, 12
4	Possess an ability to write clearly on topics related to technology and workplace communication.	Analyze	2	6, 7, 8, 9, 10, 12
5	Choose functional language, grammar structures, cohesive devices and skills of organisation to express clearly in speaking.	Evaluate	2	6, 7, 8, 9, 10, 12

LANGUAGE LAB ACTIVITIES:

- Session-1: Dictionary Skills.
- Session-2: Introduction to Phonetics and Identifying Phonemes.
- Session-3: Pronunciation Practice (Commonly mispronounced words).
- Session-4: Rosetta Stone (Exercises on LSRW).
- Session-5: Listening Comprehension (Summarising exercise on a Ted Talk).
- Session - 6: Technical Presentations (Individual).
- Session - 7: Technical Presentations (Team).
- Session - 8: TOEFL Mastery.

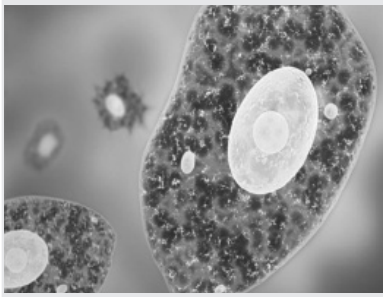
TEXT BOOKS:

1. N P Sudharshana&C Savitha,“English For Technical Communication”, 2nd edition, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Balasubramanian T,“A Text book of Phonetics for Indian Students”, 1st edition, Orient Longman, New Delhi, 1989.
2. Krishnaswamy, N and Sriraman, T,“Current English for Colleges”, 1st edition, Trinity publications, 2016.
3. Mohan Krishna and Meera Banerjee,“Developing Communication Skills”, 1st edition, Macmillan India Ltd. New Delhi, 1990.
4. Ashraf Rizvi M, “Effective Technical Communication”, 2nd Edition, McGraw Hill Education, 2017.
5. Narayana Swamy V R,“Strengthen your Writing”, 3rd Edition Orient Black Swan, New Delhi, 2005.

22BT101 CELL AND MOLECULAR BIOLOGY



Source : https://www.illumina.com/areas-of-interest/cellular-molecular-biology-research.html

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Biology and Biochemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to know different cell components and their functions like transport of material, signalling etc. And also, it imparts knowledge on cell division & cancer, structure, synthesis and processing of nucleic acids and protein synthesis in prokaryotes and eukaryotes. Further, familiarize students about the classification and types of mutations and how they affect the gene and its expression.

MODULE-1

UNIT-1 **9L+0T+6P= 15 Hours**

CELL STRUCTURE AND FUNCTION

Plasma membrane organization, cell organelles- nucleus (chromatin and chromosome organization, karyotyping, cell division), mitochondria, chloroplast, endoplasmic reticulum, golgi bodies, lysosomes, cytoskeletal elements - microtubules, microfilaments and intermediate filaments.

UNIT-2 **15L+0T+10P= 25 Hours**

CELLULAR COMMUNICATION

Types of extra cellular signal molecules and their binding mechanisms, secondary messengers, types of signaling pathways - G-protein linked cell surface receptor mediated system, enzyme-linked cell surface receptors, cell cycle- mitosis and meiosis, molecular regulation of cell cycle (check points), mechanisms of cellular death, regulation of programmed cell death.

PRACTICES:

- Karyotyping of human chromosomes along with normal, Down and Turner syndromes.
- Cell Counting by Haemocytometer.
- Meiosis.
- Mitosis.
- MTT assay.

MODULE-2

UNIT-1 **9L+0T+6P= 15 Hours**

NUCLEIC ACIDS AND DNA REPLICATION

DNA discovery and structure, DNA models (A, B, Z models), DNA denaturation and melting curves, semiconservative DNA replication of prokaryotes and eukaryotes, rolling circle replication, replication in bacteriophages, inhibitors of DNA replication, DNA damage and repair mechanisms, site directed mutagenesis and reverse genetics.

UNIT-2 **15L+0T+10P= 25 Hours**

SKILLS:

- ✓ *Regulation of cell cycle.*
- ✓ *Processing of transcripts.*
- ✓ *Modification by site-directed mutagenesis.*
- ✓ *Identify various stages of cell division and differentiation.*
- ✓ *Handling reagents, enzymes and biochemicals related to molecular biology.*

TRANSCRIPTION AND TRANSLATION

Transcription machinery, RNA polymerases, mechanism of transcription in prokaryotes and eukaryotes, posttranscriptional modifications, inhibitors of transcription, genetic code and wobble hypothesis, mechanism of translation in prokaryotes and eukaryotes, post-translational modifications.

PRACTICES:

- Isolation of genomic DNA from bacteria, plants and animals
- Tm value for the genomic DNAs of bacteria, Plants and animals.
- Quantification of extracted genomic DNA from bacteria, plants and animals.
- Restriction enzyme digestion.
- Plasmid DNA isolation.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the concepts of gene expression and regulation.	Analyze	2	1,2,4,5,6, 8,9,10
2	Analyze different mechanisms of cell signalling and role of secondary messenger pathways.	Analyze	1	2,4,5,9,10
3	Evaluate the leads of cancers through metastasis.	Evaluate	2	3,5,6,9,10
4	Design experiments incorporating the principles of microscopy and identification of different cell types.	Create	1	3,4,5,9,10

TEXTBOOKS:

1. G M Cooper, “The Cell: A Molecular Approach”, 8th edition, Oxford University Press, 2019.
2. Channarayappa, “Molecular Biotechnology: Principles and Practices”, 1st edition, CRC Press, 2007.

REFERENCEBOOKS:

1. B Alberts, A Johnson, J Lewis, M Raff, K Roberts and P Walter, “Molecular Biology of the Cell”, 6th edition, Garland Science, 2014.
2. H Lodish, A Berk, S L Zipursky, P Matsudaira, D Baltimore and J Darnell, “Molecular Cell Biology”, 6th edition, Palme, 2018.
3. Jocelyn E. Krebs, Elloit S. Goldstein and Stephen T. Kilpatrick, “Lewin’s Genes XI”, 11th edition, Jones & Bartlett Learning, 2014.

II

YEAR

B.Tech.

BIOINFORMATICS

I SEMESTER

22ST201	-	Biostatistics and Design of Experiments
22TP201	-	Data Structures
22BT201	-	Biochemistry and Enzymology
22BT203	-	Microbiology & Fermentation Technology
22BI201	-	Algorithms in Bioinformatics
22BI202	-	Biological Databases
22SA201	-	Life Skills - I

II SEMESTER

22TP203	-	Advanced Coding Competency
22TP204	-	Professional Communication Laboratory
22BI203	-	Python Programming for Biotechnologists
22BI204	-	Structural Bioinformatics and Instrumental Techniques
22CT201	-	Environmental Studies
22MS201	-	Management Science
	-	Department Elective – 1
	-	Open Elective – 1
22SA202	-	Life Skills - II

COURSE CONTENTS

I SEM & II SEM

22ST201 BIOSTATISTICS AND DESIGN OF EXPERIMENTS

Source: https://www.clinfo.eu/biostatistics/

Hours Per Week :

L	T	P	C
3	2	0	4

PREREQUISITE KNOWLEDGE: Basic engineering mathematics.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides students the foundation in elementary topics of statistics and probability such as descriptive statistics, regression analysis and probability. It also enhances the knowledge of students towards successfully analyse the practical situations with the concepts of testing of hypothesis with design of experiments.

MODULE-1

UNIT-1 **15L+0T+0P=15 Hours**

DESCRIPTIVE STATISTICS

Basic Definitions, Frequencies, Graphical Representation, Histogram, Ogive curves, Measures of Central tendency, Arithmetic mean, Median, Mode, Mean deviation, Standard deviation, Symmetry and Skewness, Karl Pearson's Coefficient of skewness, Covariance, Correlation, Types, Pearson's Coefficient of correlation, Rank correlation, Spearman's rank correlation.

UNIT-2 **15L+10T+0P=25 Hours**

REGRESSION ANALYSIS AND PROBABILITY

Regression, Linear regression lines and Properties, Introduction (Classical and Axiomatic approach), Addition theorem, Conditional probability, Multiplication theorem and Bayes theorem.

PRACTICES:

- Graphical representation (histogram, Pie Diagram and Ogive curve) of the covid-19 affected subjects in the year 2020-21. (collect the data from Google).
- Calculate arithmetic mean of the height of boy students and girl students in your class.
- Find the standard deviation for the height difference between 10 boy and girl students.
- Measure the height and weight of your class mates. Calculate the correlation coefficient between the observed height and weight.
- Draw linear regression equation between the two quantifiable hypothetical variables.

Months in the year 2021	Vaccinated Subjects	Subjects suffering from Covid-19 in my location.
May	100	2000
June	150	1850
July	250	1500
August	500	1000
September	750	500
October	850	200
November	950	100
December	1000	10

- Study the skewness of the data.
- Apply probability concepts in real time situations.

SKILLS:

- ✓ *Analyse the data using measures of central tendency*
- ✓ *Fit an appropriate curve for a given set of data*
- ✓ *Test the statistical models using ANOVA*

MODULE-2

UNIT-1 **15L+0T+0P=15 Hours**

TESTING OF HYPOTHESIS

Testing large samples-one mean, two means, one proportion and two proportions. Testing small samples-one mean, two means (independent and paired samples).

UNIT-2 **15L+10T+0P=25 Hours**

ANALYSIS OF VARIANCE

ANOVA one-way, two-way classifications, Design of experiments: completely randomized design, Randomized complete block design. Chi square tests-goodness of fit and independence of attributes.

PRACTICES:

Download a published paper on dye decolourization using design of experiments (or RSM) strategy for identifying the optimum operating conditions.

(a) Develop one parameter, multi parameter linear and nonlinear regression models with those experimental data.

(b) Develop other linear and nonlinear designs for the same set of parameters and mention their advantages and disadvantages.

Download a published paper on L-Lysine Production using design of experiments (or RSM) strategy for identifying the optimum operating conditions.

(a) Develop one parameter, multi parameter linear and nonlinear regression models with those experimental data.

(b) Develop other linear and nonlinear designs for the same set of parameters and mention their advantages and disadvantages.

Download a published paper on Production of Amylase using design of experiments (or RSM) strategy for identifying the optimum operating conditions.

(a) Develop one parameter, multi parameter linear and nonlinear regression models with those experimental data.

(b) Develop other linear and nonlinear designs for the same set of parameters and mention their advantages and disadvantages.

Download a published paper on L-asparagine production using design of experiments (or RSM) strategy for identifying the optimum operating conditions.

(a) Develop one parameter, multi parameter linear and nonlinear regression models with those experimental data.

(b) Develop other linear and nonlinear designs for the same set of parameters and mention their advantages and disadvantages.

Download a published paper on enzymatic biodiesel synthesis using design of experiments (or RSM) strategy for identifying the optimum operating conditions.

(a) Develop one parameter, multi parameter linear and nonlinear regression models with those experimental data.

(b) Develop other linear and nonlinear designs for the same set of parameters and mention their advantages and disadvantages.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

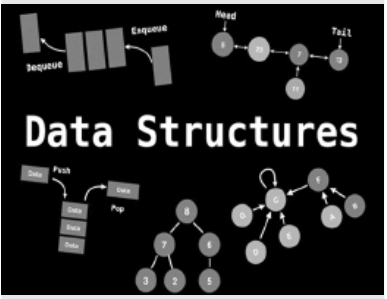
CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of statics to determine values of various descriptive measures	Apply	1	1,3,6,7
2	Analyse the fitness of the models using regression analysis.	Analyse	1	2,4,6,7
3	Design of experiments for various bioprocesses	Create	2	3,67
4	Evaluate the design models using statistical tools	Evaluate	2	3,4,7

TEXT BOOKS:

1. Khan and Khanum, 'Fundamentals of Biostatistics", 1st Edition, Ukaaz Publications, 2004.
2. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", 2nd Edition, Sultan Chand & Sons, 2012.

REFERENCE BOOKS:

1. P. R. Vittal, "Mathematical Statistics", 2nd Edition, Margham Publications, Chennai, 2018.
2. Kishore S. Trivedi, "Probability and Statistics with Realiability, Queueing and Computer Science Applications", 2nd edition, Wiley Student edition, 2008.
3. A. Singaravelu, "Probability and Statistics", 22nd edition, Meenakshi Agency, 2015.



Source: https://www.youtube.com/watch?v=Qmt0QwzEmh0

22TP201 DATA STRUCTURES

Hours Per Week :

L	T	P	C
2	2	2	4

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION AND OBJECTIVES:

This course is aimed at offering fundamentals concepts of data structures and explains how to implement them. It begins with the basic concepts of data, data structures and then introduces the primitive and non-primitive data structures in detail. It forms the basis for understanding various ways of representing data and its usage in different computing applications.

MODULE-1

UNIT-1 **5L+6T+6P = 17 Hours**

DATA STRUCTURES BASICS

Basic Terminology – data, information, datatype, Data Structures – Introduction, storage structures-sequential and linked storage representations, classification of data structures, Applications of data structures.

Sorting: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort and Merge Sort.

Searching: Linear Search and Binary Search.

UNIT-2 **11L+10T+10P = 31 Hours**

LINKED LISTS AND STACKS, QUEUES

Linked List: Introduction, Types of linked list – Singly linked list, doubly linked list and circular linked list, representation of linked list, Operations of linked list, Traverse forward/ reverse order, searching, insertion and deletion, Applications of linked lists.

Stack - Introduction, array and linked representations, implementation and their applications, Queue - Introduction, array and linked representations, implementation, Types - Linear, circular and doubly ended queues - operations, Applications of Queues.

PRACTICES:

PROBLEMS ON RECURSION - LEVEL 1

- Find the product of 2 numbers using recursion.
- Find the sum of natural numbers using recursion.
- Find the factorial of a number using recursion.
- Find the Nth term of Fibonacci series using recursion.
- Calculate the power using recursion.
- Write a recursive program for checking if a given number is a prime number.
- Given two integers write a function to sum the numbers without using any arithmetic operators.
- Convert a decimal to binary using recursion.
- Print all factors using recursion.
- Find the maximum product of digits among numbers less than or equal to N.

PROBLEMS RECURSION – LEVEL 2

1. Implement insertion sort recursively.
2. Write a program to find the numbers less than N that are product of exactly 2 distinct prime numbers - using recursion.
3. Implement selection sort recursively.
4. Find the middle of a singly linked list using recursion.
5. Find the sum of even numbers of an array using recursion.
6. Check if a given array is in sorted order using recursion.
7. Print alternate nodes of a linked list using recursion.
8. Reverse a doubly linked list using recursion.
9. Write a recursive function that returns all permutations of a given list.
10. Implement bubble sort recursively.

PROBLEMS ON SORTING AND SEARCHING – LEVEL 1

1. Implement the insertion sort function.
2. Implement the bubble sort function.
3. Implement the quick sort function.
4. Implement the merge sort function.
5. Implement the selection sort function.
6. Implement linear search function.
7. Implement binary search function.

PROBLEMS ON SLL – LEVEL 1

1. Implement the insert function to insert nodes into a singly linked list (ascending order).
2. Implement the insert function to insert nodes into a singly linked list (descending order).
3. Implement the search node function.
4. Implement the delete node function.
5. Display forwards function.
6. Display backwards function.
7. Count the number of nodes in a singly linked list.
8. Swap alternate nodes of a singly linked list.
9. Move last node to the front of the linked list.
10. Move first node to the last of the linked list.

PROBLEMS ON STACKS – LEVEL 1

1. Implement two stacks using a single array.
2. Given an array replace every element with nearest greater element on the right.
3. Given a stack reverse the elements using only push and pop functions.
4. Postfix evaluation using stack.
5. Balance symbols.
6. Find middle element in a stack.
7. Remove middle element from a stack.
8. Implement push and pop using linked list.
9. Given an array of characters with the middle marked by X, check if the string is a palindrome.
10. Maximum sum in sliding window.

PROBLEMS ON QUEUES – LEVEL 1

1. Write a program to accept two numbers as input check if they are equal.
2. Write a program to accept two characters as input and check if they are equal.
3. Write a program to accept two numbers as input and print the greater of the 2 numbers.
4. Write a program to accept two numbers as input and print the lesser of the 2 numbers.
5. Write a program to accept 3 numbers as input and print the maximum of the 3.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

6. Write a program to accept 3 numbers as input and print the minimum of the 3.
7. Write a program to accept a number as input and print EVEN if it is an even number and ODD if it is an odd number.
8. Write a program to accept a number as input and check if it is divisible by 3. If it is divisible by 3 print YES else print NO.
9. Write a program to accept a number as input and check if it is divisible by both 3 & 5. If it is divisible print YES else print NO.
10. Write a program to accept a number as input and check if it is positive, negative or zero.

PROBLEMS ON DLL – LEVEL 1

1. Implement insert function.
2. Implement display forward function.
3. Implement display backward function.
4. Implement search function.
5. Implement delete function.
6. Reverse a doubly linked list from M to N.
7. Find the sum of the odd and even nodes.
8. Count odd keys of the linked list.
9. Merge two sorted lists.
10. Delete adjacent duplicate nodes.

PROBLEMS ON CLL – LEVEL 1

1. Insert function (circular doubly linked list).
2. Search function.
3. Display forward.
4. Display backward.
5. Delete node (circular doubly linked list).
6. Print the middle N nodes of a circular singly linked list.
7. Move the last node of a circular singly linked list to the beginning.
8. Delete adjacent duplicate nodes of a circular singly linked list.
9. Delete nodes greater than a value from a circular doubly linked list.
10. Find the sum of the nodes of a circular linked list.

PROBLEMS ON LINKED LIST – LEVEL 2

1. Given 2 sorted linked lists, print the common elements.
2. Reverse a list (using Stack).
3. Given a pointer to a node (not the last node), delete the node.
4. Reverse a list (Recursive).
5. Reverse a list (Iterative).
6. Reverse a singly linked list in pairs (recursive).
7. Reverse a singly linked list in pairs (iterative).
8. Check if a singly linked list is a palindrome or not.
9. Remove the loop if exists.
10. Given 2 linked lists with data in the ascending order, merge them into a single list.

MODULE-2

UNIT-1 **8L+8T+8P=24 Hours**

TREES

Trees: Basic Terminology, Types of Trees, Binary Tree – Introduction, properties, array and linked representations, Tree traversals and their implementation, Expression trees, BST – definition and operations, AVL trees – definition and construction, Applications of binary trees.

UNIT-2 **8L+8T+8P=24 Hours**

GRAPHS & HASHING

Graphs: Basic Terminology, Types of Graphs, Graphs representations – adjacency matric, adjacency list; Traversals - breath first search and depth first search, Applications of graphs.

Hashing: Introduction, Different hash functions, collision - avoidance and handling methods.

PRACTICES:

PROBLEMS ON BST – LEVEL 1

1. Insert function.
2. Insert function (recursive).
3. Search function.
4. Pre order traversal.
5. Post order traversal.
6. In order traversal.
7. Level order traversal.
8. Delete child node.
9. Delete parent node.
10. Delete nodes greater than a value from a circular doubly linked list.

PROBLEMS ON PRIORITY QUEUES – LEVEL 1

1. Meeting rooms problem.
2. Ugly number.
3. Find median from data stream.
4. Find the top K frequent elements.
5. Find K Pairs with smallest sums.
6. Find the Kth smallest element in a sorted matrix.
7. Trapping Rain Water.
8. Rearrange String k distance apart.
9. Sort characters by frequency.
10. Solve the maze problem.

PROBLEMS ON GRAPHS – LEVEL 1

1. Implement Graph data structure.
2. Implement BFS - iterative solution.
3. Implement BFS - recursive solution.
4. Implement DFS - iterative solution.
5. Implement DFS - recursive solution.
6. Check if given graph is strongly connected or not.
7. Check if given graph is strongly connected or not - using DFS.
8. Given a graph find the arrival and departure time of its vertices in DFS. Arrival time is the time when the vertex was explored for the first time, and departure time is the time at which all the neighbours are explored and are ready to backtrack.
9. Given a directed acyclic graph and a source vertex, find the cost of the shortest path from source vertex to all other vertices present in the graph. If a vertex cannot be reached from given source vertex that distance may be printed as infinite.
10. Given an undirected graph, check if the graph is 2 edge connected or not.

PROBLEMS ON HASHING – LEVEL 1

1. Print a binary tree in vertical order.
2. Find whether an array is subset of another array.
3. Given an array A [] and a number x, check for pair in A [] with sum as x.

4. Minimum operation to make all elements equal in array.
5. Maximum distance between two occurrences of same element in array.
6. Check if a given array contains duplicate elements within k distance from each other.
7. Find duplicates in a given array when elements are not limited to a range.
8. Most frequent element in an array.
9. Smallest subarray with all occurrences of a most frequent element.
10. First element occurring k times in an array.

PROBLEMS ON GRAPHS – LEVEL 2

1. Find the shortest graph distances between every pair vertex in a given path. Assume that the graph does not have any negative edges.
2. Find the shortest graph distances between every pair of vertices in a given path. The graph can have negative edges.
3. Detect cycle in DFS.
4. Count the number of connected components of a graph represented in the adjacent matrix.
5. Count the number of connected components of a graph represented in the adjacent matrix - using DFS.
6. Find a spanning tree - not necessarily a minimum spanning tree.
7. Detect cycle in an undirected graph.
8. Given an undirected graph, find its depth.
9. Determine if a directed graph has a unique topological ordering.
10. Given a directed acyclic graph and two vertices v and w, find the lowest common ancestor.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explore the organization of several ADTs and the manipulation (searching, insertion, deletion, traversing) of data stored in various data structures.	Apply	1,2	1
2	Apply different data structures to solve a given problem.	Apply	1,2	1
3	Analyze the efficiency of using different data structures and choose the efficient data structure for solving a given problem.	Analyze	1,2	2
4	Develop new algorithms to solve various problems.	Create	1,2	3,4

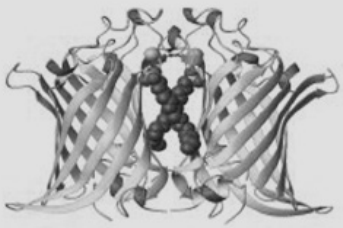
TEXT BOOKS:

1. ReemaThareja, “Data Structures Using C”, 2ndEdition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCEBOOKS:

1. Ellis Horowitz and SartajSahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2ndEdition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

22BT201 BIOCHEMISTRY AND ENZYMOLOGY



source: https://biochemistry.conferenceseries.com/events-list/enzymology-biochemistry

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biology and Organic chemistry.

COURSE DESCRIPTION AND OBJECTIVES:

This course is intended to imbibe concepts of biological macromolecules and their role in the metabolism. It also focuses on classification, isolation and kinetics of enzymes.Techniques employed in estimation and characterization of biomolecules are also emphasized.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

BIOMOLECULES & THEIR METABOLISM

Mono, di, oligo and polysaccharides, Stereoisomerism and optical isomerism of sugars, Nitrogen cycle, Amino acids, physio chemical properties of amino acids, Organizational structure of proteins, Lipids - Importance & Classification, Fatty acids Structures and properties, Storage Lipids & membrane lipids, Structure and properties of purines and pyrimidines, nucleic acids.

UNIT-2 **15L+0T+10P=25 Hours**

METABOLISM OF NITROGEN COMPOUNDS

Metabolism of carbohydrates - Glycolysis, Krebs cycle, Electron Transport chain, Gluconeogenesis, Entener-Doudoroff pathway, Pentose Phosphate pathway and its importance in nucleic acid synthesis, Metabolism of amino acids - Glutamate pathway, Serine pathway, Shikimate pathway, Metabolism of lipids-Biosynthesis of fatty acids, Beta oxidation, Metabolism of purines and pyrimidines - biosynthesis and degradation.

PRACTICES:

- Qualitative assessments of Carbohydrates and proteins.
- Comparison of the estimation of reducing sugars by Benedicts & Dinitro-salicylicacid (DNSA) method in relation to their sensitivity and specificity.
- Comparison of protein quantification by Biuret & Lowry methods in relation to their sensitivity, specificity and interference.
- Estimation of DNA by diphenylamine method.
- Estimation of RNA by Orcinol method.
- Estimation of Cholesterol by Zak method.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

CONCEPTS OF ENZYMES

Classification of enzymes, Principles of catalysis - collision theory, transition state theory, Role of entropy in catalysis, Concept of active site and energetics of enzyme substrate complex formation, Specificity of enzyme reaction, Methods of immobilization of enzymes-physical & chemical techniques, Limitation & applications of immobilized enzymes.

SKILLS:

- ✓ *Detection of macromolecules by biochemical and calorimetric assays.*
- ✓ *Quantification of biomolecules using spectro-photometer.*
- ✓ *Purification and quantification of enzymes from various sources.*
- ✓ *Analyzing the effect of parameters such as concentration of substrate, pH and temperature on enzyme production.*

UNIT-2 **15L+0T+10P=25 Hours**

ENZYME KINETICS

Kinetics of single substrate reactions: Michaelis–Menten model, Multi-substrate reaction mechanisms and kinetics, Types of Inhibition -kinetic models, Substrate and product inhibition, Allosteric regulation of enzymes, Kinetics of immobilized enzyme, Effect of external mass transfer & intra-particle diffusion, Bioreactors using immobilized enzyme.

PRACTICES:

- Extraction of at least three commercially important enzymes and their characterization.
- Purification of enzymes – Ammonium sulfate precipitation & dialysis.
- Determination of enzyme activity & specific activity.
- Estimation of Michaelis - Menten parameters.
- Effect of pH on enzyme activity.
- Effect of temperature on enzyme activity.
- Techniques of enzyme immobilization: matrix entrapment, ionic and cross linking.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Employ suitable technique for characterization of biological macromolecules.	Apply	1	1, 2, 4, 5, 9, 10, 12
2	Appraise the significance of biomolecules in maintaining the homeostasis.	Analyse	1	1,2,4,5,9, 10
3	Categorize the nature of enzymes and able to appreciate their role in cellular functioning.	Analyse	2	1,2,4, 5, 9, 10
4	Evaluate the influence of physico-chemical properties of enzymes during their industrial application.	Evaluate	2	1,2,4, 5, 9, 10

TEXT BOOKS:

1 J L Jain, Sunjay Jain and Nitin Jain, “Fundamentals of Biochemistry”, 7th edition, S Chand, 2016.
2. T Palmer and P L Bonner, “Enzymes: Biochemistry, Biotechnology, Clinical Chemistry”, 2nd edition, Affiliated East-West press, 2017.

REFERENCE BOOKS:

1. David L. Nelson and Michael M. Cox Lehninger, “Principles of Biochemistry”, 8th edition, W. H. Freeman & Co, 2021.
2. J M Berg, John L Tymoczko and L Stryer, “Biochemistry”, 9th edition, W.H. Freeman, 2019.
3. Donald Voet, Judith G. Voet, “Biochemistry”, 4th edition, Wiley, 2010.

22BT203 MICRO BIOLOGY AND FERMENTATION TECHNOLOGY

source: https://www.scientificbio.com/biomass-monitoring/

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basics of Biology.

COURSE DESCRIPTION AND OBJECTIVES:

The main objective of the course is to familiarize the students to understand the classification, diversity and physiology of microorganisms. It emphasizes on the methods of microbe cultivation, sterilization techniques, microbial diseases, host pathogen interactions and their control. Further, it enables the students about design of fermentation process, media and prediction of nutritional and other process variables on the production of bioproducts.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

FUNDAMENTALS OF MICROBIOLOGY

Spontaneous generation theory, germ theory of diseases, microscopy-types, staining techniques, characteristics used in microbial taxonomy, sterilization processes - physical agents and chemical agents, evaluation of effectiveness of anti microbial agents, biosafety levels.

UNIT-2 **15L+0T+10P=25 Hours**

MICROBIAL DIVERSITY

Characteristic features and biological importance of viruses, bacteria, fungi, yeast and algae. Molecular basis of pathogenicity, human diseases caused by viruses, bacteria and fungi, Emerging infectious diseases.

PRACTICES:

- Sterilization techniques in microbiology.
- Microscopic examination of microorganisms.
- Gram staining of bacteria.
- Evaluation of effectiveness of anti microbial agents.
- Biochemical tests for identification of bacteria.
- Culturing and identification of fungal organisms.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

FERMENTATION PROCESES

Design and construction of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes, nutrient requirement for fermentation process, culture media and types, medium optimization techniques with special emphasis on statistical techniques, pure culture techniques, microbial growth and measurement, improvement of industrially important micro organisms, preservation of pure cultures.

SKILLS:

- ✓ *Handle different microscopes.*
- ✓ *Isolation and identification of microbes from various sources.*
- ✓ *Microbial species differentiation.*
- ✓ *Aseptic maintenance of lab and hood.*
- ✓ *Maintenance of stock cultures.*
- ✓ *Handling of microbial fermentation process in fermenter.*

UNIT-2 **15L+0T+10P=25 Hours**

TYPES OF FERMENTATION

Batch culture, continuous culture, fed-batch culture- applications and examples, solid state fermentation, development of inoculum for microbial, yeast, fungal and animal cell cultivations, supply of air/nitrogen for aerobic and anaerobic process, aeration andagitation.

PRACTICES:

- Fermentation media for cultivation of microorganisms.
- Isolation of pure cultures by streak plate and pour plate technique.
- Preservation of purecultures.
- Microbial growth measurement - Viable cell count method.
- Microbial growth measurement - Turbidity estimation.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Categorize different characteristic features of micro organisms under microbial taxonomy.	Analyze	1	1,2,5,4,7,9,10
2	Apply the control agents against disease causing pathogens.	Apply	1	1,5,6,9,10
3	Evaluate the role of micro organisms in various fields.	Evaluate	1	1,3,4,5,6,9,10
4	Design fermentation media for enhanced growth and product formation.	Create	2	1,2,3,4,5,6,9,10
5	Analyze fermentation processes for industrial production of bioproducts.	Analyze	2	1,3,4,5,6,9,10

TEXT BOOKS:

1. Joanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton, “Prescott’s Microbiology”, 10th edition, Mc Graw Hill, 2017.
2. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall,“Principles of Fermentation Technology”, 3rd edition, Elsevier, 2016.

REFERENCE BOOKS:

1. Douglas S. Clark and Harvey W. Blanch,“Biochemical Engineering”, 2nd edition, CRC Press, 1997.
2. Michael L Shuler, Fikret Kargi and Matthew P DeLisa,“Bio process Engineering: Basic Concepts, 3rd edition, Pearson. 2017.
3. S. Krupanidhi, A. Venkata Narayana, D. JohnBabu, “Handbook of Fermentation Technology-Instant Class Notes” (eBook), 1st edition, Pothi, 2015.
4. K. R. Aneja, “Experiments in Microbiology Plant Pathology and Biotechnology”, 4th edition, New Age International limited, 2007.

22BI201 ALGORITHMS IN BIOINFORMATICS

source: https://www.istockphoto.com/photo/holographic-display-of-advance-dna-sequence-analysis-gm1221783874-358273848

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Programing in 'C', Biological data bases

COURSE DESCRIPTION AND OBJECTIVES:

This course is to familiarize with the computational problems in biology useful for aligning sequences, phylogeny and sequencing technologies. The overall objective of the course is to train the students to improvise the understanding of algorithms used in Bioinformatics.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

ALGORITHMS

Algorithms and complexity, biological algorithms versus computer algorithms, iterative versus recursive algorithms, big-O notations and algorithm design techniques.

UNIT-2 **10L+0T+10P=20 Hours**

TYPES OF ALGORITHMS

Exhaustive search, mapping algorithms, greedy algorithms, approximation algorithms.

PRACTICES:

- Retrieving nucleotide sequence from gen bank database.
- Retrieving protein sequence from Swissprot database
- Retrieving pathways from KEGG & BRENDA
- Global alignment using Neddleman Wunsch algorithm.
- Local alignment using Smithwatermann algorithm.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

DNA SEQUENCE ALIGNMENT

DNA sequence comparison, Scoring alignment, Global sequence alignment, Local sequence alignment, Alignment with gap penalties, Multiple sequence alignment.

UNIT-2 **10L+0T+10P=20 Hours**

EVOLUTIONARY TREES

DNA sequencing, fragment assembly in DNA sequencing, protein sequencing and identification. gene expression analysis, evolutionary trees Construction-Distance based methods and Character based methods

SKILLS:

- ✓ *Enhancing logical thinking for analyzing biological problems.*
- ✓ *Integration of computational programme to fetch answers for bio-systems.*
- ✓ *Develop robust programming by implementing dynamic programming skills*

PRACTICES:

- Multiple sequence alignment of sequences using ClustalW.
- Protein Secondary structure prediction by SOPMA.
- Phylogenetic tree construction using MEGA.
- Finding ORF's using gene prediction methods.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze biological data using algorithms of bioinformatics.	Analyze	1	1,2,4,5,9,10
2	Select suitable algorithms to solve a given biological problem.	Analyze	1	2,3,5,9,10
3	Design bioinformatics prediction algorithms.	Develop	2	3,4,5,9,10
4	Apply dynamic programming, sequence clustering and weight matrices for alignment.	Apply	2	1,4,5,9,10

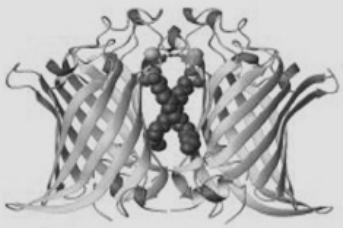
TEXT BOOKS:

1. 1. Gollery Martin, "Bioinformatics: Sequence and Genome Analysis ', 2nd edition, publisher, 2005.
2. NeilCJonesandPavelAPevzner,"AnIntroductiontoBioinformaticsAlgorithms",1stedition, MITPress,2004.

REFERENCE BOOKS:

1. Wing-Kin Sung, "Algorithms in Bioinformatics: A Practical Introduction", 1st edition, CRC Press,2009.
2. Arthur Lesk, "Introduction to Bioinformatics", 1stedition, Oxford, 2002
3. T. K Attwood and D J Smith, "Introduction to Bioinformatics", 1stedition, Pearson Education, 2005.

22BI202 BIOLOGICAL DATABASES



source: https://biochemistry.conferenceseries.com/events-list/enzymology-biochemistry

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biochemistry, Cell and Molecular Biology

COURSE DESCRIPTION AND OBJECTIVES:

This course demonstrates the importantance of building the databases in biological context for analysing biomolecules like DNA, RNA, and proteins. It also aids in data mining for sequence alignment and analysis.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

BIOLOGICAL DATABASES AND ITS TYPES

Primary and secondary databases, Nucleic acid Databases, Primary (NCBI, DDBJ & EMBL, Protein Databases0 Uniprot and PDB), Secondary (PIR, SCOP, CATH)

UNIT-2 **15L+0T+10P=25 Hours**

SEQUENCE ANALYSIS

Various sequence file formats in bioinformatics, Formats - (plain sequence format, EMBL, Flat, Fasta, FastQ, GCG, Genbank and IG); Basic concepts of Scoring matrices: (PAM and BLOSUM), various versions of BLAST and interpretation of results.

PRACTICES:

- Retrieval of DNA, RNA sequences from GenBank, DDBJ, AND EMBL
- SWISSPROT - searching and retrieval of protein sequences in different formats for analysis by various softwares.
- PIR - using of protein information resource to support genomic and proteomic research activities.
- TrEMBL - a supplement of SWISS-PROT for analyzing and evaluating protein sequences.
- PDB - retrieval of protein structure for analysis.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

SEQUENCE ALIGNMENT AND VISUALIZATION

Pairwise sequence alignment, DOT Plots (BLAST and FASTA), Dynamic programming algorithms, Pairwise alignment methods such as Smith-Waterman and Needleman- Wunsch; Multiple sequence alignment; ClustalW, Toffee.

UNIT-2 **15L+0T+10P=25 Hours**

PROTEIN SEQUENCE ANALYSIS

Amphiphilicity detection using Kyte-Dolittle plot; use of HMM for Transmembrane prediction; Protein secondary structure prediction by using Chou-Fassman, GOR, J Pred and Garnier.

SKILLS:

- ✓ *Construction of databases*
- ✓ *Data mining form biological databases*
- ✓ *Sequence alignments*

PRACTICES:

- SCOP - analyze proteins having structural similarities for checking the common evolutionary origin.
- CATH - classification of protein structures based on sequences downloaded from PDB.
- Pfam - multiple sequence alignment of proteins in to clans and families.
- PROSITE and BLOCKS - database of protein families and domains.
- UCSC Genome Browser - UCSC on-line genome browser access to genome sequence data from a variety of vertebrate and invertebrate species integrated with a large collection of aligned annotations.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Retrieve the sequences from biological databases	Apply	1	1,4,5,9,10
2	Compare the sequence similarity among biomolecules using substitution matrices.	Analyze	1	2,4,5,9,10
3	Interpret structural features of biomolecules using visualization tools.	Analyze	2	3,4,5,6,9,10
4	Predict the secondary structural elements of proteins using R-plot.	Analyze	2	3,4,5,6,9,10

TEXT BOOKS:

1. Aurther M lesk, “Introduction to Bioinformatics”, 3rd edition, Wiley, 2019.
2. David W Mount, “Bioinformatics: Sequence and Genome Analysis”, 2nd edition, Cold Spring Harbor Press.

REFERENCE BOOKS:

1. R. Durbin, “Biological Sequence Analysis”, Cambridge University Press, 1998.
2. R. M. Holmes, “A Cell Biologists’ Guide to Modeling and Bioinformatics” Wiley Interscience, 2007.

22TP203 ADVANCED CODING COMPETENCY

source: https://www.geeksforgeeks.org/best-way-to-start-with-competitive-programming-geeksforgeeks-cp-live-course/

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Programming in C, Data Structures.

COURSE DESCRIPTION AND OBJECTIVES:

This course helps to understand the impact of the choice of data structures and design strategies to solve the problem in an efficient manner. This course also provides the understanding of advanced graph applications and also throw light in tractable intractable problems.

MODULE-1

UNIT-1 **0L+0T+8P =8 Hours**

STACKS, QUEUES AND SINGLE LINKED LISTS

PRACTICES:

Problems On Stacks & Queues

- Check if given stack of integers are consecutive or not (could be ascending or descending).
- Find the maximum sum in a sliding window using queues.
- Given a queue of integers, rearrange the elements by interleaving the first half with the second half.
- Given an integerk and a queue of integers, reverse the order of the first k elements of the queue.
- Given a maze in the form of a rectangular matrix filled with O, X or M where O represents an open cell, X represents a blocked cell and M represents landmines, find the shortest distance of every open cell in the maze from its nearest mine.
- For a given parenthesis expression, check whether it is balanced parenthesis or not.
- Reverse a number using stack.
- You are given a string s consisting of lowercase English letters. A duplicate removal consists of choosing two adjacent and equal letters and removing them. We repeatedly make duplicate removals on s until we no longer can.
- Find first Unique character in a string (Queue).
- Implement Tower of Hanoi problem.

Problems On Linked Lists

- Given a random pointer to a random node in a singly linked list, clone the list.
- Given a list rotate the list to the right by k places.
- Remove duplicates from a sorted list.
- Find fractional node in a singly linked list.
- Sort a linked list using constant space complexity.
- Delete a node in start, middle, end of Singly linked list.
- Add a node in start, middle, end of Singly linked list.
- Find whether given single linked list is circular or not.
- Arrange a singly linked list in Descending order.
- Addition of two numbers using Singly Linked List.

SKILLS:

- ✓ *Experienced to Store data and various types of data to handle.*
- ✓ *Ordering and sorting of data.*
- ✓ *Indexing and Searching of required data from large data sequences.*
- ✓ *Exposed to various characteristics such as Linear or non-linear, Homogeneous or heterogeneous and Static and Dynamic.*

UNIT-2 **0L+0T+8P =8 Hours**

DOUBLY LINKED LISTS, CIRCULAR LINKED LISTS

PRACTICES:

Problems on Double Linked Lists and Circular Linked Lists.

- Implement a clockwise rotation of a doubly linked list by N places.
- Count triplets in a sorted doubly linked list whose product is equal to a given value x.
- Find the product of all prime nodes in a doubly linked list.
- Find the count of common nodes in two doubly linked lists.
- Find pairs with given product in a sorted doubly linked list.
- Delete all the even nodes of a circular singly linked list.
- Count nodes in a circular linked list.
- Delete all prime nodes from a circular singly linked list.
- Exchange first and last nodes in a circular linked list.
- Reverse a doubly circular linked list.
- Linear search using a stack of incomplete sub problems.
- 1 2 3 4 5 6 in stack S is push X is pop, SSSSXXSSSXXX.
- Recursively remove all adjacent duplicates.
- Check if a given singly linked list is a palindrome using stack.
- Convert a multilevel singly linked list to a singly linked list.
- Remove duplicates from an unsorted doubly linked list.
- Sort a doubly linked list using insertion sort.
- Check if a doubly linked list of characters is palindrome or not.
- Swap Kth node from beginning with Kth node from end in a Double Linked List.
- Convert a Binary Tree into Double Linked List.

MODULE-2

UNIT-1 **0L+0T+8P =8 Hours**

TREES

PRACTICES:

Problems on Trees

- Given a sorted doubly linked list, convert it into a balanced BST.
- Given a singly linked list with data in the ascending order, convert it into a height balanced BST.
- Print the leaf to root path for every leaf node in a binary tree.
- Write a function to implement the reversed level order traversal of a binary tree.
- Truncate a given binary tree to remove nodes that lie on a path having sum less than K.
- Find the vertical sum in a given binary tree.
- Delete minimum & Maximum element from a BST.
- Implement Inorder, preorder and postorder tree traversal techniques.
- Print Kth largest element in a BST.
- Implement Zig-Zag tree traversal.

UNIT-2 **0L+0T+8P =8 Hours**

GRAPHS

PRACTICES:

Problems on Graphs.

- Given a directed acyclic graph, determine whether there is a path that visits every vertex exactly once.
- Reverse a directed graph such that each edge from v to w is replaced by an edge from w to v.
- Find the shortest path in a graph that visits each vertex at least once, starting and ending at the same vertex.
- Find the minimum number of throws required to win a snake and ladder game.
- Implement DFS of a Graph.
- Implement BFS of a Graph.
- Detect whether a cycle is present in an undirected graph.
- Detect cycle in a Directed Graph.
- Find Shortest Distance to goal node from root node in a graph.
- Find no.of nodes in Kth level of a Graph.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various data structures to solve a different algorithm.	Apply	1,2	1
2	Investigate the various data structures to solve a given problem in an efficient manner.	Analyse	1,2	2
3	Design and implement an appropriate hashing function for an application.	Create	1,2	4

TEXT BOOKS:

1. ReemaThareja, “Data Structures Using C”, 2nd Edition, Oxford University Press, 2014.
2. Seymour Lipschutz, “Data Structures with C”, 1st Edition, McGraw Hill Education, 2017.

REFERENCEBOOKS:

1. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, illustrated edition, Computer Science Press, 2006.
2. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2nd Edition, CENAGE Learning, 2005.
3. R G Dromey and Pearson, “How to solve it by Computer”, 2nd edition, Impression edition, 1998.

Source : https://www.coursera.org/specializations/improve-english

22TP204 PROFESSIONAL COMMUNICATION

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: High School-level English.

COURSE DESCRIPTION & OBJECTIVES: To improve the overall professional communication skills (LSRW) of students and prepare them for their profession as engineers and managers. To provide them exposure to conventions of corporate communication and training them on how to function in the business world.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

BASICS OF BUSINESS WRITING SKILLS, PRACTICING BUSINESS CORRESPONDENCE AND REPORT WRITING

Business English Vocabulary: Glossary of most commonly used words (formal and informal usage).

Elements of Technical Writing: Sentence structure, reducing verbosity, arranging ideas logically, building coherence, cohesive devices and transitional words.

Mechanics of Writing: elementary rules of grammar, choice of diction, elementary principles of composition, matters of form, punctuation, conventions of business communication, language and professional tone, code of conduct (not sending illegal, offensive, disparaging personal remarks or comments) in written business communication.

Business Correspondence: E-mail: nature and scope, e-mail etiquette, clear call for action, common errors in composing e-mails, office communication such as meeting agenda and notice, circular and memo.

Letter-Writing: Formal and informal letters, structure of formal letters, expressions of salutations, different types of letters [such as sales letter, complaint letter, response to the complaint letter (dispute resolution), letter of permission, letter of enquiring, claim letter – letter of apology etc], introductory and concluding paragraphs and clear call for action.

Professional Proposal/Report: Differentiating proposals and reports, Drafting formal business proposals, types of reports such as factual reports, feasibility reports and survey reports, parts of a report (such as title page, declaration, acknowledgements, table of contents, abstract, introduction, findings, conclusion and recommendations).

New Age Corporate Communication Media: Importance of social media communication and Etiquettes, form and structure, sharing texts through Twitter, Whatsapp, instgram etc.

UNIT-2 **0L+0T+8P=8 Hours**

PRACTICING COMMUNICATIVE LANGUAGE IN VARIOUS PROFESSIONAL CONTEXTS

Speaking: Speaking in business context, assertiveness, politeness, making requests, queries and questions, negotiations, asking for information, offering suggestions, conflict resolution, contacting clients, initiating, addressing delegates (in public), delivering the presentation effectively, telephone etiquettes, delivering seminar/proposal/report effectively, team meeting etiquettes (face to face and conference call), making effective one minute presentations(JAM) and participating in Group Discussions.

PRACTICES:

- Basic grammar practice, framing paragraphs on topics allocated, paraphrasing an article or a video in your own words, finding topic sentences in newspaper articles, finding out new words from a professional viewpoint and understanding the meaning and its usage.
- Perusing samples of well-prepared business emails, memo, letter writing and short proposals

and reports, students will draft business correspondence writing tasks and different proposals/ reports on topics assigned.

- Watching videos/listening to audios of business presentations, classroom activities of team and individual presentations, using PPTs, mock exercises for BEC speaking, agreeing, disagreeing politely, developing content, extended speaking in Group Discussion(s).

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

READING AND COMPREHENDING BUSINESS DOCUMENTS

Reading: Reading and comprehending business documents, learning business register, regularizing the habit of reading business news, suitable vocabulary, skimming and scanning a text for effective and speedy reading and dealing with ideas from different sectors of corporate world in different business contexts.

UNIT-2 **0L+0T+8P=8 Hours**

IMPARTING AND PRACTICING LISTENING SKILLS

Listening: Specific information in business context, listening to telephonic conversations / messages and understanding the correct intended meaning, understanding the questions asked in interviews or in professional settings, summarizing speaker's opinion or suggestion, enable active listening.

PRACTICES:

- Hand-outs - matching the statements with texts, finding missing appropriate sentence in the text from multiple choices, using right vocabulary as per the given context and editing a paragraph.
- Working out BEC/TOEFL/IELTS listening exercises with hand-outs; matching the statements with texts, finding missing appropriate sentence in the text from multiple choice- multiple choices, using right vocabulary in context-editing a paragraph, listening to a long conversation such as an interview and answer MCQ s based upon listening.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Possess comprehensive skills in listening and reading business texts in formal context.	Apply	2	7
2	Communicate effectively both in their academic as well as professional environment.	Apply	1, 2	10
3	Clear grasp on the register of business language.	Analyze	1	8
4	Possess the ability to write business reports and proposals clearly and precisely to succeed in their future.	Create	1	12
5	Make effective presentations and participate in formal context.	Create	2	10

TEXT BOOKS:

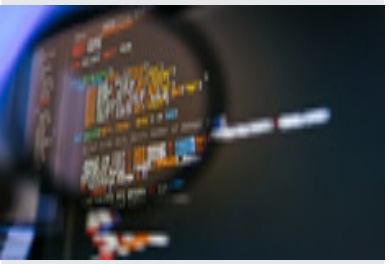
1. S. Schnurr,"Exploring Professional Communication: Language in Action", London: Routledge, 2013.

REFERENCE BOOKS:

1. Brook Hart Guy,"Cambridge English Business Bench Mark: Upper Intermediate", 2ndEdition: CUP, 2014.
2. Cambridge University Publication, "Cambridge: BEC VANTAGE Practice Papers", CUP, 2002.
3. J. Seely, "The Oxford Guide to Effective Writing and Speaking", OxfordUniversity Press, 2005.

SKILLS:

- ✓ *To enhance listening and spoken abilities of students needed for professional and social success in interpersonal situations, group interactions, and personal and professional presentations.*
- ✓ *Understand and practice specific functions and vocabulary in a business context.*
- ✓ *Produce short business reports, proposals and correspondence.*
- ✓ *Write various business documents through reading techniques.*



source:https://lifelonglearning.dtu.dk/en/bioengineering/course/python/

22BI203 PYTHON PROGRAMMING FOR BIOTECHNOLOGISTS

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Programming in C.

COURSE DESCRIPTION & OBJECTIVES:

The course content consists of two main parts. The first part deals with an introduction to python, the goal of which is to lay down the basics of algorithms and programming languages in general. The second part is an introduction to biopython, which is a package based on python, so we will apply what was understood in the first part.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

ESSENTIALS OF PYTHON

Features of python, installing python packages via PIP, Variables, Assignment, Keywords, Input-output, Indentation, Basic data types, Operators and Expressions, Control structures; Python data structures.

UNIT-2 **15L+0T+10P=25 Hours**

OBJECT ORIENTED PROGRAMMING IN PYTHON

Strings - creation, accessing, operators, methods; Sets - creation, accessing, operators, methods; List comprehensions; Functions - defining functions, calling functions, passing arguments - keyword arguments, default arguments, variable-length arguments, anonymous functions (lambda); Classes, 'self-variable' methods, Constructor method, Inheritance, Overriding Methods, Data hiding.

PRACTICES:

- Write a Python program that asks the user for two DNA sequences, and prints the reverse complement of their concatenation.
- Write a Python program that asks the user for a DNA sequence, and prints both the corresponding mRNA sequence and protein sequence, including stop codons (according to the standard translation table).
- Write a Python program that asks the user for a DNA sequence, andprints both the corresponding mRNA sequence and protein sequence, including stop codons (according to the Yeast Mitochondrial Code translation table).
- Write a Python program that takes the sequence of the 1AI4 PDB protein (download the FASTA file manually), and writes a corresponding UniProt file.
- Write a Python program that takes the sequences.fasta file and writes N single-sequence FASTA files, called sequence{number}.fasta, each one containing a single sequence of the original file.
- Write a Python program that takes the sequences.fasta file and writes a revcomp.fasta file with the reverse complements of the original sequences. Hint. The SeqIO.write() function can write an entire list of SeqIO records.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

BIOPYTHON

Tetra nucleotide Frequency: Counting Things, Transcribing DNA into mRNA: Mutating Strings, Reading and Writing Files, Reverse Complement of DNA: String Manipulation, Computing GC Content: Parsing

FASTA and Analyzing Sequences, Finding the Hamming Distance: Counting Point Mutations, translating mRNA into Protein: More Functional Programming, find a Motif in DNA: Exploring Sequence Similarity.

UNIT-2 **15L+0T+10P=25 Hours**

ADVANCED BIOPYTHON

Overlap Graphs: Sequence Assembly Using Shared K-mers, Finding the Longest Shared Subsequence: Finding K-mers, Writing Functions, and Using Binary Search, finding a Protein Motif: Fetching Data and Using Regular Expressions, Finding Open Reading Frames, DNA Synthesizer: Creating Synthetic Data with Markov Chains

.**PRACTICES:**

- Find and download a single sequence record from genbank. The genbank identifier of the record is HE805982.1. This record contains information about the DNA region coding for HBx, a multifunctional hepatitis B viral protein involved in modulating several pathways by directly or indirectly interacting with hosts factors (protein degradation, apoptosis, transcription, signal transduction, cell cycle progress, and genetic stability). Write a Python program that, using the genbank record, saves the corresponding protein sequence in fasta format.
- From UniProt find and download the records relative to the four human ELAV proteins (ELAVL1: Q15717, ELAVL2: Q12926, ELAVL3: Q14576, ELAVL4: P26378). Download each record in text format and store the four records in a dedicated directory. Now write a python program that takes all the uniprot files in the directory and appends all the sequences in fasta format, to the file created in the previous exercise. Can you print sequences ordered by increasing length? [Hint. The os.listdir() function in the os module can save in a list all the names of the files in a directory.]
- Write a program that, given a fasta file containing multiple protein sequences and a string specified by the user, prints to a new file only sequences that contain at least one occurrence of the string (regular expressions are allowed). Test your program with the file sequences.fasta, printing sequences containing a stretch of at least three glutamines.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the principles of Python in biological problems	Apply	1	1,4,5,9,10
2	Create a search engine using Bio python	Create	1	2,3,5,9,10
3	Analyse the sequence input/output files	Analyze	2	2,3,4,5,9,10
4	Perform pairwise sequence alignment, multiple sequence alignment & phylogeny.	Apply	2	2,3,5,9,10
5	Evaluate custom functions for DNA sequence analysis and protein synthesis	Evaluate	2	2,3,4,5,9,10

TEXT BOOKS:

1. 1. David Beazley, “Python essential reference”, 2nd edition, New Riders,2001.
2. Mitchell L. Model, “Bioinformatics Programming Using Python: Practical Programming for Biological Data (Animal Guide)”, 1st edition, O’Reilly Media, 2009.

REFERENCE BOOKS:

1. 1. Sebastian Bassi, “Mathematical and Computational Biology Python for Bioinformatics”, 2nd edition, Chapman and Hall / CRC, 2017.
2. Tim J. Stevens, Wayne Boucher, “Python Programming for Biology: Bioinformatics and Beyond”, 1st edition, Cambridge University Press, 2015.
3. Brad Dayley, “Python Phrasebook: Essential Code and Commands”, 1st edition, Sams, 2006
.

SKILLS:

- ✓ *Filtering the sequences containing ambiguous or low-quality bases.*
- ✓ *Running the standalone Blast server.*
- ✓ *Performing multiple sequence alignment using modules of Biopython*

Source : https://www.biooekonomie-bw.de/en/articles/dossiers/industrial-biotechnology-biological-resources-for-industrial-processes

22BI204 STRUCTURAL BIOINFORMATICS AND INSTRUMENTAL TECHNIQUES

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biochemistry & Enzymology, Biological databases

COURSE DESCRIPTION & OBJECTIVES:

This course introduces fundamental concepts and methods of instrumentation and structural bioinformatics. It also covers sequences, X–ray diffraction, structure and function databases of DNA & protein molecules, advanced sequence and structure alignments, methods of protein folding and protein structure prediction and techniques of protein structure determination.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

AMINO ACIDS AND PROTEINS

Biomolecules and their interactions, size and shape of macromolecules, Structure of proteins, Properties of amino acids, Ionization of amino and carboxyl groups in amino acids and peptides, Ionization of side chains, configuration of natural amino acids, polarity of amino acid side chains, composition of proteins, Metallic proteins, proteins as enzymes and hormones, predicting properties of proteins from amino acid compositions.

UNIT-2 **10L+0T+10P=20 Hours**

CONFORMATIONAL AND STRUCTURAL ANALYSIS OF BIOMOLECULES

Polypeptide chains geometrics, potential energy calculations, observed values for rotation angles, hydrogen bonding, hydrophobic interactions, ionic interactions, disulphide bonds, prediction of proteins structure, Ramachandran Plot, General characteristics of nucleic acid structure, geometrics, glycosidic bond, rotational isomers and those puckering, backbone rotational isomers and ribose puckering, forces stabilizing ordered forms, base pairing, base stacking tertiary structure of nucleic acids, protein folding and misfolding

.**PRACTICES:**

- Predict the tertiary structure of proteins
- Calculate the properties and composition of amino acids for different proteins.
- Analysis of secondary structure of proteins using Ramachandran diagram (Phi-Psi map).
- Visualize the non-bonded interactions of proteins with/without ligands.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

INSTRUMENTAL TECHNIQUES

X–ray diffraction, X-ray crystallography, determination of molecular structures, electron microscopy, neutron scattering and light scattering. Flow cytometry; Infra-Red spectroscopy; Proton and 2D-NMR; X-ray spectroscopy; Mass spectroscopy.

UNIT-2 **10L+0T+10P=20 Hours**

ADVANCED TECHNIQUES IN SEPARATION

Ultra centrifugation and density gradient centrifugation; Electrophoresis-principles and types; Chromatography - general principles and its applications; Liquid and gas chromatography, Ion-exchange chromatography, gel - filtration chromatography, affinity chromatography and HPLC

.**PRACTICES:**

- Separation of blood cells using a density gradient centrifugation.
- SDS-PAGE and Agarose gel electrophoresis for separation of molecules.
- Purification of biological macromolecules using Ion Exchange chromatography.
- ractionation of bioactive compounds using gel filtration chromatography.
- Characterization of bioactive compounds through HPLC..

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze different structural levels of biological macromolecules	Analyze	1	2,4,5,9,10
2	Examine the 3D structures of macromolecules for target site identification	Analyze	1	2,4,5,6,9,10
3	Apply the techniques of chromatography for purifications of biomolecules	Apply	2	1,3,5,9,10
4	Analyze the results of XRD, NMR and Mass spectrometry	Analyze	2	2,3,4,5,9,10

TEXT BOOKS:

1. 1. Keith Wilson, and John Walker, “Principles and Techniques of Biochemistry and Molecular Biology”, 7th edition, Cambridge University Press, 2013.
2. J. Jayaraman, “Laboratory Manual in Biochemistry”, 2nd edition, New Age International, 2011.

REFERENCE BOOKS:

1. K. Wilson, K. H. Goulding, “A Biologist Guide to Principles and Techniques of Practical Biochemistry”, 7th edition, Cambridge University Press, 2006.
2. Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch “Fundamentals of Analytical Chemistry”, 9th edition, Cengage learning, 2013.
3. Frank A. Settle, “Hand Book of Instrumental Techniques for Analytical Chemistry”, 1st edition, Prentice Hall, 1997.

SKILLS:

- ✓ *Predictive analysis of secondary structure of proteins.*
- ✓ *Analyze the protein structure in terms of various quality parameters*
- ✓ *Experience in characterization of biomolecules*

Source :
Biogas plant at VFSTR

22CT201 ENVIRONMENTAL STUDIES

Hours Per Week :

L	T	P	C
1	1	0	1

PREREQUISITE KNOWLEDGE: General awareness regarding environmental problems and importance of environmental protection.

COURSE DESCRIPTION & OBJECTIVES:

It is a multidisciplinary subject where different aspects of society and environment are dealt using a holistic approach. Itis evolving to be the education for sustainable and ethical development both at a local and global level. It helps to prepare the next generation for planning appropriate strategies to address environmental issues. It identifies and creates solutions that conserve to manage ecosystem and biodiversity and helps to eliminate pollutants, toxicants, preserve air, water and soil quality. Environmental education recognizes impacts of global issues, enhances the public awareness and helps to take decisions towards environmentally responsible actions.

MODULE-1

UNIT-1 **4L+4T+0P=8 Hours**

NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY

Environment and sustainable development, Natural resources- forest, water, energy and land resources; Ecosystem-basic structural components, function and interactions in ecosystem, ecological succession.

UNIT-2 **4L+4T+0P=8 Hours**

BIODIVERSITY AND CONSERVATION

Introduction to biodiversity, types of biodiversity - species, genetic and ecosystem diversity, Threats to biodiversity - natural and anthropogenic, species extinctions, man wildlife conflicts, Biodiversity conservation - principles and strategies, in-situ and ex-situ conservation.

PRACTICES:

- Visit to a Biogas plant, Solar Power plant.
- Visit to a local area: river/pond/lake/forest / grassland / hill /mountain and study of different.
- types of ecosystems, biodiversity study and documentation (herbarium sheet preparation).
- Set up an aquarium.
- Case study: Renewable energy use.

MODULE-2

UNIT-1 **4L+4T+0P=8 Hours**

ENVIRONMENTAL POLLUTION AND CLIMATE CHANGE

Air, water, soil, radioactive and noise pollution, Study of different pollutants (SOx, NOx, PAN, PAH etc.); Toxicity study, Climate change - greenhouse effect, acid rain, ozone layer depletion.

UNIT-2 **4L+4T+0P=8 Hours**

POLLUTION CONTROL DEVICES AND WASTEWATER TREATMENT TECHNOLOGIES

Air pollution control devices - Gravitational settling chambers, cyclonic separators, electrostatic precipitators, fabric filters and bio filters, Waste water management.

PRACTICES:

- Visit to a sewage treatment plant and waste water analysis.
- Case study: Recycling Technologies.
- Case study: Effects of contaminants on microorganisms.
- Report writing: 12 principles of green chemistry for environmental sustainability.
- Report writing: Environmental Impact Analysis, Local Disaster Management Plan.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic concepts of sustainable development, natural resource utilization and ecology for the purpose of environmental protection.	Apply	1	1,6,7, 9, 10, 11, 12
2	Design remediation technologies for their abatement.	Apply	2	1, 3,6,7, 9, 10, 11, 12
3	Analyze the biodiversity of different ecosystems and formulate various conservation approaches	Analyze	1	1, 7, 8, 9, 10, 11, 12
4	Analyze the presence of various environmental pollutants.	Analyze	2	1, 6,7,9, 10, 11, 12
5	Recommend various waste management approaches and their implementation strategies.	Evaluate	2	1,2, 7,8,9,10,11, 12

TEXT BOOKS:

1. A. Kaushik and C. P. Kaushik, “Perspectives in Environmental Studies”, New Age International Publishers, 5th Edition, 2016.
2. Y. Anjaneyulu, “Introduction to Environmental Science”, 1st edition, B. S. Publications, 2015.

REFERENCE BOOKS:

1. B. Joseph, “Environmental Studies”, Mc Graw Hill Education, 2nd Edition, 2015.
2. S. Subash Chandra, “Environmental Science”, 1st eidition New Central Book Agency, 2011.
3. M.Basuand S.Xavier, “Fundamentals of Environmental Studies”, 2nd edition Cambridge University Press, 2016.

SKILLS:

- ✓ *Create a bio-diversity map of any habitat/ ecosystem.*
- ✓ *Strategize different ways of using renewable energy resources.*
- ✓ *Design novel strategies and approaches for pollution control and waste management.*

Source : https://xueqi326.wordpress.com/semester-3/management-science/

22MS201 MANAGEMENT SCIENCE

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basic knowledge on management.

COURSE DESCRIPTION & OBJECTIVES:

The goal of this course is to analyse the importance of management, significance of operation management and carry out production operations through work-study. Students will be able to analyse the markets, customers, competitors, and then plan HR function effectively.

MODULE- 2

UNIT- 1 **6L+6T+0P=12 Hours**

INTRODUCTION TO MANAGEMENT

Concepts of Management and organization- nature, importance and Functions of Management, Systems approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Mayo's Hawthorne Experiments, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Leadership Styles, Social responsibilities of Management.

UNIT- 2 **10L+10T+0P =20 Hours**

OPERATIONS MANAGEMENT

Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement,Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records. Statistical Quality Control: control charts for variables and attributes (simple Problems), Acceptance Sampling

PRACTICES:

- Collect some examples with videos for types of production.
- Carry out production operations through work-study.
- Practice problems with Inventory control methods and Quality Control charts.

MODULE- 2

UNIT- 1 **8L+8T+ 0P =16 Hours**

HUMAN RESOURCES MANAGEMENT

Concepts of Human Resource Management, Basic functions of HR Manager - Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

UNIT- 2 **8L+8T+0P =16 Hours**

MARKETING MANAGEMENT

Evolution of Marketing, Functions of Marketing Selling Vs Marketing, 4 P's of Marketing – Product Mix - Product Life Cycle – Place Mix – Channels of Distribution – Price Mix – Pricing Methods – Promotion Mix – Tools of Promotions.

PRACTICES:

- Select any Designation in an organization and try to describe its job description and job specifications.
- How do you deal with grievances at your work.
- Analyze marketing mix in various situations.

SKILLS:

- ✓ *Expert in managerial skills.*
- ✓ *Maintain social relations.*
- ✓ *Evaluate pricing strategies.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the nature and importance of management.	Analyze	1	1,2,4,6
2	Significance of Operations Management.	Analyze	1, 2	1,2,5
3	Carry out production operations through work-study.	Apply	1, 2	1, 2, 3, 5
4	Analyze the markets, customers, and competition.	Analyze	2	1,2,4,5,6
5	Plan and control the HR function effectively.	Evaluate	1, 2	1,2,3,4,5,6

TEXT BOOKS:

1. Stoner, Freeman, Gilbert, “Management”, 6th edition, Pearson Education, New Delhi, 2004.
2. Aryasri, “Management Science”,1st edition, TMH, 2004.

REFERENCE BOOKS :

1. Kotler Philip & Keller Kevin Lane, “Marketing Mangement”, 12th edition, PHI, 2005.
2. Koontz & Weihrich, “Essentials of Management”, 6th edition, TMH, 2005.
3. Thomas N. Duening& John M. Ivancevich, “Management - Principles and Guidelines”, 1st edition, Biztantra, 2003.

III

YEAR

B.Tech.

BIOINFORMATICS

I SEMESTER

22TP301	-	Soft Skills Laboratory
22BI301	-	Bioprocess Engineering
22BI302	-	Genetic Engineering
22BI303	-	Heat and Mass Transfer
	-	Department Elective – 2
	-	Open Elective – 2
22BI305	-	Industry Interface Course (Modular course)
22BI304	-	Inter-Disciplinary Project – Phase-I

II SEMESTER

22TP302	-	Quantitative aptitude & Logical reasoning
22BI306	-	Data mining & Machine Learning for Bioinformatics
22BI307	-	Molecular Phylogenetics
	-	Department Elective – 3
	-	Department Elective – 4
	-	Open Elective – 3
22BI308	-	Inter-Departmental Project/Course

COURSE CONTENTS

I SEM & II SEM

22TP301 SOFT SKILLS LABORATORY

Source: https://www.kgi.edu/news/what-is-bioprocess-engineering/

Hours Per Week :

L	T	P	C
0	0	2	1

PREREQUISITE KNOWLEDGE: Grasp on their own academic achievements.

COURSE DESCRIPTION AND OBJECTIVES:

To impart employability skills like resume preparation and facing interviews. To enable trainees to develop interpersonal and leadership skills and to train them on work place skills like making presentations, participating in group discussions etc.

MODULE-1

UNIT-1 **0L+0T+8P=8 Hours**

PERSONALITY DEVELOPMENT

Soft Skills: Need for soft skills, professionalism, employability skills, Communication - Need for effective communication - the process of communication, levels of communication, flow of communication, choice of diction and style with reference to setting (formal, semi-formal or informal), communication networks, barriers to communication, miscommunication, noise and ways to overcome the barriers; Career Planning: Job vs. career, SWOT analysis.

UNIT-2 **0L+0T+8P=8 Hours**

LANGUAGE AND VOCABULARY

Vocabulary Building: Word etymology, roots, prefixes & suffixes, synonyms & antonyms, collocations, one-word substitutes, analogies, idioms and phrases, contextual guessing of unfamiliar words, task-oriented learning, Reflection of language on Personality, Gender sensitive language in MNCs, Mind your language, Seven essential skills for a team player; attentive listening, intelligent questioning, gently persuading, respecting other's views, assisting others, sharing, participating actively.

PRACTICES:

- Self-Introduction.
- Personal and Academic SWOT.
- Johari Window.
- Giving and taking opinions of Self Vs others and assessing oneself.
- Goal setting.
- Short, Mid and Long Term goals planning the semester.
- Time management: four quadrant system.
- Stephen Covey Time Management Matrix planning a semester.
- Stress-management.
- Questionnaire to assess level of stress.
- 50 words towards resume preparation and interviews.
- Newly coined words.
- Gender sensitive words and Words acceptable in Indian context and objectionable international context.

SKILLS:

- ✓ *Balance social and emotional intelligence quotients though SWOC, JOHARI etc. activities.*
- ✓ *Prepare tailor made resume and face various job interviews with enriched personality traits.*
- ✓ *Career planning with clear personal and professional goals.*
- ✓ *Solve personal and professional life hiccups with confidence and maturity.*

MODULE-2

UNIT-1 **0L+0T+8P=8 Hours**

LANGUAGE IN ACTION

Functional English: Situational dialogues, Role plays (including small talk); Group Discussion: Articulation and flow of oral presentation, dynamics of group discussion, intervention, summarizing and conclusion, voice modulation, content generation, Key Word Approach (KWA), Social, Political, Economic, Legal and Technical Approach (SPELT), View Point of Affected Part (VAP), language relevance, fluency and coherence - 11th and 12th weeks, Resume preparation - Structure and presentation, defining career objective, projecting one's strengths and skill-sets, summarizing, formats and styles and covering letter-Statement of Purpose.

UNIT-2 **0L+0T+8P=8 Hours**

PREPARING FOR PRESENTATIONS AND INTERVIEWS

Facing Interviews: Interview process, understanding employer expectations, pre-interview planning, opening strategies, impressive self-introduction, answering strategies, other critical aspects such as body language, grooming, other types of interviews such as stress-based interviews, tele- interviews, video interviews, frequently asked questions (FAQs) including behavioral and HR questions and the aspect looked at by corporate during interviews; Presentation Skills - Selection of a topic, preparing an abstract, gathering information, organizing the information, drafting the paper, citing reference sources – writing striking introductions, discussing the methodology used, developing the argument, presentation style, language, presenting the paper and spontaneously answering audience questions.

PRACTICES:

- Opening and closing a telephonic conversation.
- Making an appointment.
- Making a query.
- Offering/Passing on information.
- Communicating with superiors.
- Expressing agreement/objection.
- Opening bank account (combination of prepared and impromptu situations given to each student).
- Group Discussions on various topics.
- Preparing SoP and Resume.
- Mock interviews on the FAQs including feedback.
- Oral presentation with the help of technology (Preparing PPT and presenting).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

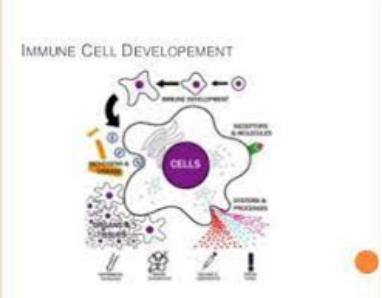
CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Have the ability to introspect on individual strengths and weaknesses, and emerge as a balanced personality with improved self-awareness and self-worth .	Apply	1	12
2	Observe gender sensitive language and workplace etiquette in his professional life.	Analyze	1	9
3	Be able to prepare a resume and gain the confidence to face an interview.	Create	1, 2	10
4	Possess the interpersonal skills to conduct himself/herself effectively in everyday professional and social contexts.	Apply	2	8
5	Bring professionalism into his/her daily activities.	Create	2	8

TEXTS BOOKS:

1. Adrian Furnham, “Personality and intelligence at work”, Psychology Press, 2008.
2. S. P. Dhanvel, “English and Soft skills”, Orient Blackswan, 2011.

REFERENCE BOOKS:

1. Edward Holffman, “Ace the corporate personality”, McGraw Hill, 2001.
2. John Adair Kegan Page, “Leadership for innovation”, Kogan, 2007.
3. Krishna Mohan and NP Singh, “Speaking English effectively”, Macmillan, 2008.



source: https://www.slideshare.net/MekhlaDiwan/immunoinformatics-microarray-and-machine-learning-all-about-immunology-immunological-database

22BI301 IMMUNOLOGY AND IMMUNOINFORMATICS

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology; Biochemistry and Enzymology.

COURSE DESCRIPTION AND OBJECTIVES:

The course on Immunology and immune informatics is designed in such a way that the topics related to concepts in immunology, cellular components of immune system, innate and adaptive immune responses and their components are introduced in the first module. This is being followed by the practical exercises. In the second module, the immune informatics tools are focused so as to enable students to design vaccine using the online tools.

MODULE-1

UNIT-1 **9L+0T+6P= 15 Hours**

FUNDAMENTALS OF IMMUNOLOGY

Types of Immunity: innate and adaptive; humoral and cell mediated; Immune cells and lymphoid organs; Antigens-epitopes – factors influencing antigenicity; Software tools for predicting antigenicity; Antigen processing and presentation; HLA: Role and Types; Cytokines - types and immune response; T & B cells-Activation and differentiation; Applications of Immunoinformatics tools.

UNIT-2 **15L+0T+10P= 25 Hours**

CLINICAL IMMUNOLOGY

Inflammation; Hypersensitive reactions; Immune checkpoint inhibitors for cancer therapy; Autoimmunity, Monoclonal antibodies - production and applications; Humanized & Bi-specific antibodies; Structure and types of Immunoglobulins.

PRACTICES:

- Isolation of lymphocytes from the mouse spleen and thymus.
- Identification and enumeration of mouse and human leukocytes.
- Hemagglutination test for blood grouping and evaluation of antigen and antibody behavior in vitro.
- Navigate HLA database to trace HLA haplotypes of Indian population. Focus on the population of Andhra Pradesh.
- Prepare a chart showing the Hybridoma Technology.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

ANTIGEN ANTIBODY INTERACTIONS

Antibody affinity and activity; Ouchterlony double immunodiffusion and precipitation; Antibody titer; Agglutination; RIA; ELISA; Western Blotting; Immunofluorescence; MLR; FACS; Vaccines: various platforms of vaccines, vaccine composition; Disease burden due to the vaccine preventable diseases.

UNIT-2 **15L+0T+10P=25 Hours**

IMMUNOINFORMATICS

Design of multi-subunit and polytope vaccines; Population coverage based on HLA haplotypes; HLA Haplotypes of the population of state of Andhra Pradesh; Prediction of epitopes in vaccine design; Web based tools for vaccine design; IMGT- HLA - KIR databases

PRACTICES:

- Antibody titer.
- Immunodiffusion and precipitation.
- ELISA Test for the estimation of antigen/antibody/protein.
- Mapping of the burden due to vaccine preventable diseases. (e.g. Covid-19, Malaria)
- Prediction of Epitope: Conformational and sequential epitopes.
- Design of multi-subunit polytope vaccine.
- Preparation of antigen and adjuvant emulsion (mineral oil, alum, Freund's adjuvants, etc.).
- Immunization of mouse through intramuscular and intraperitoneal routes.

SKILLS:

- ✓ *Immunize lab animals for the production of antibodies.*
- ✓ *Work on immunodiffusion techniques.*
- ✓ *Perform ELISA.*
- ✓ *Purify IgG.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply cellular machinery of immune system to recognize pathogen and its antigens.	Apply	1,2	1,3,7,9,10
2	Analyze the immune factors involved in the defence mechanisms against viruses, bacteria, fungi and nematode parasites.	Analyze	1	1,2,3,9,10
3	Evaluate immune techniques as life saving devices.	Evaluate	1	3,5,7,8,9,10
4	Design experimental protocols using antigen and antibody immune complexes.	Create	1,2	3,6,7,9,10
5	Design a vaccine using immunoinformatics online tools.	Create	2	1,3,5,9,10

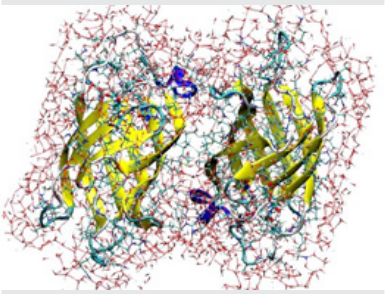
TEXT BOOKS:

1. Thomas J Kindt, Barbara A Osborne, Richard A Goldsby and J Kuby, "Immunology", 9th edition, W H Freeman, 2016.
2. Gregory R. Bock and Jamie A. Goode, "Immunoinformatics: Bioinformatic strategies for better understanding of immune function",1st edition, Wiley, 2003

.

REFERENCE BOOKS:

1. Rajat K De and Namrata Tomar, "Immunoinformatics", 2nd edition, Humana, 2014.
2. Kenneth Murphy, "Janeway's Immunobiology", 9th edition, Garland Science, 2016.
3. R. L. Myers, "Immunology: A laboratory manual", 2nd edition, William C Brown, 2007.
4. Lydyard, P. M., Whelan, A., & Fanger, M. W. "Kingdom tittle of instant notes in immunology", 3rd edition, Taylor and Francis, 2011.



source: https://stemskillslab.com/product/photography-for-beginners

22BI302 MOLECULAR MODELLING AND SIMULATIONS

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology, Biochemistry & Enzymology .

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with applications of computer modelling and simulation of biological macro molecules. The targeted areas are protein and nucleic acids structure modelling, structure-based drug design, intermolecular interactions and binding.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

COMPUTATIONAL QUANTUM MECHANICS

Quantum mechanics, Schrodinger wave equation – Born-Oppenheimer approximation Molecular Orbital Theory – Hartree – Fock equations –Electron density distributions - Cartesian and internal coordinates, Density functional theory – Empirical force field models - molecular mechanics - United atom force fields – parametrisation and transferability of force fields.

UNIT-2 **15L+0T+10P=25 Hours**

METHODS FOR EXPLORING ENERGY SURFACE

Energy minimization methods, Simplex and Sequential univariate methods – Steepest descent minimization – Conjugate gradient method - Newton-Raphson method

.**PRACTICES:**

- Perform molecular modeling using modeler
- Molecular simulation of tripeptides and carbohydrate
- ab initio structure prediction
- DFT study of small molecules

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

MOLECULAR SIMULATION AND CONFORMATIONAL ANALYSIS

Molecular Dynamics Simulation-Monte Carlo Simulation-Random number generation – Difference in MD & MC-Systematic methods for exploring conformational space – model building and random search -simulated annealing – Comparison of different conformational search approaches

UNIT-2 **15L+0T+10P=25 Hours**

APPLICATIONS OF MOLECULAR MODELING AND CHALLENGES

Comparison of 3D structures – Steps in Homology modelling – tools – databases – side chain modelling – loop modelling – Free energy calculations – Entropy and enthalpy differences - threading – molecular docking - Structure based drug design – molecular descriptors – QSAR.for genomic analysis in R, comparative phylogenetic tests, Data Manipulation in R with dplyr, Exploratory Biological Data Analysis with R, RNAseq data analysis in R, Chip-Seq data analysis.

PRACTICES:

- Molecular Dynamics simulation of protein-ligand complex.
- Visualization and analysis of Molecular Dynamics trajectory.
- Free energy-based calculations of protein-ligand complexes.
- QSAR based study using molecular descriptors.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply molecular modelling techniques to ongoing research	Apply	1	1,3,5,9,10
2	Evaluate the successes and limitations of molecular modelling	Evaluate	1	2,4,5,9,10
3	Analyze the results of molecular modelling and dynamic simulations	Analyze	2	2,4,5,6,9,10
4	Evaluate and discuss current literature related to molecular modelling	Evaluate	2	2,4,5,9,10

TEXT BOOKS:

1. 1. Leach A.R, “Molecular Modelling Principles and Application”, Pearson – Prentice Hall, New Delhi, 2nd Edition, 2009.
2. Hinchliffe A, “Theoretical chemistry Modelling molecular structures”, 2nd edition, John Wiley, 2000.

REFERENCE BOOKS:

1. Hinchliffe A, “Molecular Modelling for Beginners”, John Wiley – Thomson Press, 1st Edition, 2003.
2. Satya Prakash G., “QSAR and Molecular Modeling”, Springer - Anamaya Pub, 2nd Edition, 2008.
3. Claude C. N, “Molecular Modeling in Drug Design”, Academic Press, 1st Edition, 2006.

SKILLS:

- ✓ *Performing molecular dynamic simulations for macromolecular complexes*
- ✓ *Application of quantum mechanics to small molecules*
- ✓ *Calculating the binding and free energy of protein-ligand complex*

source: https://www.simplilearn.com/bioinformatics-where-biology-and-data-science-meet-article

22BI303 R PROGRAMMING FOR BIOLOGICAL DATA SCIENCES

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Python programming, C programming.

COURSE DESCRIPTION AND OBJECTIVES:

This course emphasizes on R programming skills for solving biological problems and familiarizing with reading and writing of files in R & manipulate and visualize data for creating different plots. Students will work with most popular biological packages in R which will allow them to perform data analysis effectively.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

FUNDAMENTALS OF 'R'

Install R & R studio; Objects; Functions; Sample with replacements; Writing your own functions - The function constructor, arguments, scripts, R Objects: Atomic vectors; Attributes; Matrices; Arrays; Class; Coercion; Lists; Data frames; Loading data; Saving data, Loops, RMySQL Package, R MySQL Commands, Querying the Tables; Query with Filter Clause; Updating Rows in the Tables; Inserting Data into the Tables; Creating Tables in MySql; Dropping Tables in MySql.

UNIT-2 **15L+0T+10P=25 Hours**

GRAPHICS & R PACKAGES

Creating graphs; The plot () Function; Customizing Graphs; R Packages & Loading and Saving Data in R, Linear models; Simple linear regression; Multiple regression; Generalized linear models - Logistic regression, poisson regression; Other generalized linear models; Survival analysis; Nonlinear models.

PRACTICES:

- Write R program to read CSV file to find and remove the missing values in a given dataset.
- Write R program for classification of a given datasets using the KNN, Naive Bayes and Decision tree
- Write R program to predict the relationship among the variables using regression.
- Calculate GC content using sequin package

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

MULTIVARIATE AND TREE-BASED METHODS

Multivariate EDA, and Principal Components Analysis; Cluster Analysis; Discriminant Analysis; Decision Tree models (Tree-based models), A Simple PCA using Vegan, Time series analysis, false discovery.

UNIT-2 **15L+0T+10P=25 Hours**

ADVANCED R OPERATIONS FOR BIOLOGICAL DATA ANALYSIS

Tools for genomic analysis in R, comparative phylogenetic tests, Data Manipulation in R with dplyr, Exploratory Biological Data Analysis with R, RNAseq data analysis in R, Chip-Seq data analysis.

PRACTICES:

- Write a program for finding the number of occurrences of each 1 and 2 -nucleotide words
- Installing and managing Bioconductor packages in R studio.
- Perform differential expression gene Analysis with limma package in R studio
- ChIP-seq analysis to locate the epigenetic peptide markers.

SKILLS:

- ✓ *Developing R program for classification of given datasets*
- ✓ *Differential Expression Analysis with suitable package in R*
- ✓ *ChIP-seq data analysis using Bioconductor package*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

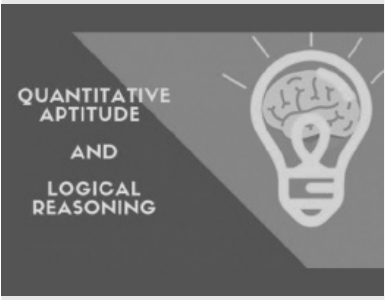
CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply linear and non-linear regression techniques for compiling complex biological data	Apply	1	1,3,5
2	Investigate results obtained for a given data set by using R- statistics	Evaluate	1	2,4,5
3	Analyze correlation analysis for the data sets that is specific to a research problem	Analyze	2	2,4,5,6
4	Develop a R program to predict the relationship among the variables	Create	2	2,3,4,5,6
5	Evaluate minimum amount of solvent required for given degree of absorption mass transfer process	Evaluate	2	2,4,5,7,9,10

TEXT BOOKS:

1. Garrett Grolemund, “Hands-on Programming with R”, 1st edition, O’Reilly Press, 2014.
2. Norman Matloff, “The Art of R Programming”, 1st edition, No Starch Press, 2017.
3. Johannes Ledolter, “Data Mining and Business Analytics with R”, 1st edition, Wiley publishers, 2014.

REFERENCE BOOKS:

1. Michael J, Crawley, “The R Book”, 1st edition, Wiley Publishers, 2012.
2. Sinha, P.P., Bioinformatics with R cookbook, 2nd edition, Birmingham: Packt., 2014
3. Gentleman, Robert, “R programming for bioinformatics”, 2nd edition, Chapman and Hall/CRC, 2008.



source: https://images.app.goo.gl/kvtVgA8TkvDCqLhj7

22TP302 QUANTITATIVE APTITUDE AND LOGICAL REASONING

Hours Per Week :

L	T	P	C
1	0	2	2

PREREQUISITE KNOWLEDGE: Basic Logical Thinking and Problem Solving Ability.

COURSE DESCRIPTION AND OBJECTIVES:

The Students will be introduced to various Arithmetic and Reasoning Problems. The students will have acquaintance with various problems like Time & Work, Time & distance, Percentages, Profit & Loss etc. besides solving puzzles and Critical Reasoning.

MODULE-1

UNIT-1 **4L+8T+0P=12 Hours**

NUMERICAL APTITUDE-I : Number system, LCM & HCF of numbers, Percentage, Ratio and proportion, Profit, loss and discount, Average & Mixtures, Simple Interest & Compound interest.

UNIT-2 **4L+8T+0P=12 Hours**

NUMERICAL APTITUDE-II : Time and work, Time & distance, Problems on trains, Problems on ages, Permutation & Combinations, Probability.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class.
- Students would have to solve 10 additional problems as a home work assignment in each concept.

MODULE-2

UNIT-1 **4L+8T+0P=12 Hours**

REASONING-I : Number series, Letter series, Analogy, Odd man out, Coding and decoding, Syllogisms-Statement & Conclusions, Puzzle test.

UNIT-2 **4L+8T+0P=12 Hours**

REASONING-I : Blood relations, Direction sense test, Order & Ranking, Seating Arrangements, Calendar & Clocks.

PRACTICES:

- Each concept would be taught in detail in the class followed by 10 problems solved in the class. Students would have to solve 10 additional problems as homework assignments in each concept.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Meet the demands of current job market besides equipping them higher studies like CAT, GMAT etc.	Apply	1	2, 5
2	Solve Arithmetic and Reasoning Problems within shortest possible time without paperwork.	Apply	1	2, 5
3	Exhibit better analytical skills and aptitude skills.	Analyse	2	2, 4
4	Develop interpretational skills.	Evaluate	2	2, 4

TEXT BOOKS:

1. R. S. Aggarwal,"Quantitative Aptitude for Competitive Examinations", S. CHAND Publications- Revised Edition, 2017.
2. ARIHANT, "A New Approach to Verbal & Non-Verbal Reasoning", Arihant Publication- Revised Edition, 2021.

REFERENCE BOOKS:

1. Trishna Knowledge Systems, "Quantitative Aptitude for Competitive Examinations", Pearson Publication, 2013.
2. R. S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", Revised Edition, S. CHAND Publications, 2018.

SKILLS:

- ✓ *Helps in developing and improving problem-solving skills.*
- ✓ *Flexing and honing logical abilities.*
- ✓ *Allow students to develop critical thinking skills.*

source: https://www.azolifesciences.com/article/Is-Machine-Learning-the-Future-of-Bioinformatics.aspx

22BI306 DATA MINING AND MACHINE LEARNING FOR BIOINFORMATICS

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Python Programming, R programming .

COURSE DESCRIPTION AND OBJECTIVES:

This course will cover and illustrate the whole process of practical applications from the life sciences, computer science, and commerce. Several machine learning topics including classification, prediction, and clustering are included. Students will learn and use the open source R statistical software, see http://www.r-project.org, and machine learning packages.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

DATA MINING

Data ware housing- OLAP - Data Preprocessing, Mining Data Streams Stream Data model - Sampling Data in a Stream – Filtering Streams – Counting distinct elements in a stream – Estimating Moments – Counting Ones in a window – Decaying windows, Machine Learning Methods: Artificial intelligence vs Machine Learning vs Deep Learning, Support Vector Machine: (SVMs). Types of learning: Supervised, Unsupervised and Reinforcement learning. Models in Machine Learning: Linear Regression, Non-Linear Regression, Decision Tree Regression, Random Forest Regression, Naïve Bayes, K-Nearest Neighbours. ANN. Data collection and processing: Where to collect Data and How to collect Data: UCSC, OMIM, PDB, IEDB. Importing Data through Kaggle API. Model optimization and Model Evaluation using Ligand and Receptor libraries: ChEMBL, ZincBind, Binding DB.

UNIT-2 **15L+0T+10P=25 Hours**

LIBRARIES: PYTHON LIBRARIES FOR MACHINE LEARNING

Numpy, Pandas, Matplotlib, Seaborn, Sklearn. Biopython libraries: MSA, BLAST, NCBI's ENTREZ, ENCODE.Tensor Flow and its applications

.**PRACTICES:**

- Introduction to MATLAB.
- Application of Fuzzy Logic concept.
- Artificial Neural Network for Bioinformatics.
- Practical Application of Bioinformatics Tools of MATLAB.
- Application of Genetic Algorithm in Bioinformatics.
- Problem Solving based on Hidden Markov Model.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

MACHINE LEARNING AIDED DRUG DESIGN

Introduction to chem-informatics, Database screening for identification of potential drug candidates, Pharrmacophore-modeling, Chemical structure and property relationships, Quantitative structure property relationship, Linear Regression Theory, Lead Optimization and identification.

UNIT-2 **15L+0T+10P=25 Hours**

PREDICTING GENE EXPRESSION USING DEEP LEARNING

Clustering and Classification. Prediction of gene expression from chromatin information: Deep learning for expression and chromatin prediction: DNA methylation and gene expression. Strong enhancers and Weak enhancers for gene expression. Splicing prediction: Tissue-specific splicing.

.**PRACTICES:**

- Genomics and proteomics data using decision theories, decision trees, and random forests
- Gene expression data using linear classification, logistic regression, SVM, clustering, and biclustering.
- Biological sequence data using expectation-maximization methods and hidden Markov models.
- Biological data sets using R packages for machine learning.
- Computational experiments for training and evaluating machine learning methods for solving bioinformatics problems.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Explore data from databases for design of computational models.	Create	1	3,4,5,7,9,10
2	Apply ML based tools for development of models.	Apply	1	1,5,6,9,10
3	Screening of small molecules for development of novel drug like molecules using AI/ML based tools.	Analyze	2	2,4,5,9,10
4	Apply deep learning algorithms for evaluation of gene expression data.	Apply	2	1,3,5,9,10

TEXT BOOKS:

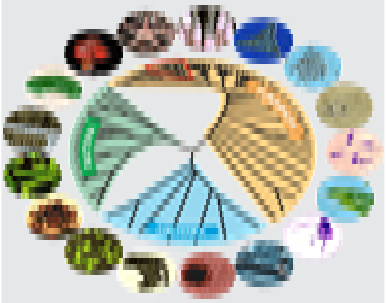
1. 1. Pierre Baldi, Soren Brunak, “Bioinformatics: The machine learning approach”, 2nd edition, MIT Press, 2001.
2. Pramod Singh, AvinashManur, “Learn Tensor Flow 2.0: Implement Machine Learning and Deep Learning Models with Python”,1st edition, Academic Press. 2019.

REFERENCE BOOKS:

1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville, “Deep learning”,1st edition, MIT press, 2016.
2. Brown, Nathan, “Artificial Intelligence in Drug Discovery”,1st edition, Royal Society of Chemistry, 2020.
3. Müller, Andreas C., and Sarah Guido, “Introduction to machine learning with Python: a guide for data scientists”, 1st edition, O’Reilly, 2016.

SKILLS:

- ✓ *Design of computational models using deep learning platforms.*
- ✓ *Prediction of prevalence of vector borne diseases using data mining algorithms.*
- ✓ *Analyze expression profiles using ML tools*



source: http://sgugenetics.pbworks.com/w/page/38479261/The%20History%20and%20Basis%20of%20Molecular%20Phylogeny

22BI307 MOLECULAR PHYLOGENETICS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biological databases.

COURSE DESCRIPTION AND OBJECTIVES:

The course is designed to unravel the molecular data hidden behind the organic evolution. The objective of the course is to find the utility of software packages in inferring the phylogeny.

MODULE-1

UNIT-1 **6L+0T+0P=06 Hours**

SYSTEMATICS AND CLASSIFICATION

Sympatric population and allopatric population; Sibling species and polytypic species; Homology, parallelism and convergence; Hardy-Weinberg principle.

UNIT-2 **10L+0T+16P=26 Hours**

MECHANISM OF SPECIATION

Species concepts- examples; Mechanism of divergence- genetic flow, genetic drift, mutation, natural selection and sexual selection, synapomorphies, homoplasy and convergent evolution

.**PRACTICES:**

- Calculate the percentage of heterozygous individuals in the population. (two allele frequencies need to be provided).
- Calculate the percentage of homozygous recessive in the population. (two allele frequencies need to be provided).
- Calculate the percentage of individuals homozygous for the dominant allele. (Recessive genotype of a trait is 0.09).
- Calculate the percentage of homozygous dominant and heterozygous individuals. (38% of individuals are recessive homozygous).
- In a population that is in Hardy-Weinberg equilibrium, if 160 out of 200 individuals are Rh+, calculate the frequencies of both alleles.
- In the United States, approximately one child in 10,000 is born with PKU (Phenylketonuria), a syndrome that affects individuals homozygous for the recessive allele (aa). (i) Calculate the frequency of this allele in the population. (ii) Calculate the frequency of normal allele. (iii) Calculate the percentage of carriers of the trait within the population.
- In a certain African Population, 4% of the population is born with sickle cell anemia (aa). Calculate the percentage of individuals who enjoy the selective advantage of the sickle-cell gene (increased resistance to malaria)?.

MODULE-2

UNIT-1 **6L+0T+0P=06 Hours**

MOLECULAR PHYLOGENIES

Immunological techniques; Nucleic acid phylogenies based on DNA-DNA hybridizations; Nucleic acid phylogenies based on restriction sites; Nucleic acid phylogenies based on nucleotide sequence comparisons and homologies.

UNIT-2 **10L+0T+16P=26 Hours**

PHYLOGENETIC TREES

Rooted trees and unrooted trees; Rooting phylogenetic trees; Tree confidence bootstrapping and estimating the reliability of phylogenetic trees; Types of trees; Cladogram; Phylogram; Dendrogram; Gene tree vs. species tree

.**PRACTICES:**

- Build a likely phylogram using manual method for the four aligned genomic DNA sequences provided.
- Build a likely phylogram using manual method for the five aligned amino acid sequences.
- Build a most likely phylogram for the four chromosomal maps (cytogenetic ideograms) provided.
- Construct a representative cladogram considering the shared ancestry of the five primate genera: Homo, Pan, Gorilla, Pongo and Macaca.
- Using MEGA software tool construct a Dendrogram for the species of Gastropods considering the conserved genes.
- Using MEGA software tool construct a Dendrogram for the strains of Corona virus considering the Spike protein.

SKILLS:

- ✓ *Differentiating the types of speciation.*
- ✓ *Identifying the factors influencing speciation.*
- ✓ *Assessing the allele and gene frequencies using Hardy-Weinberg principle.*
- ✓ *Constructing the Phylogentic tree using suitable software*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the molecular data in relation to organic evolution.	Analyse	1	2,4,5,9,10
2	Explore phylogenetic analysis to diagnose the outburst of viral epidemics.	Apply	1	2,3,5,7,9,10
3	Apply the concepts of phylogeny in the disease outbreaks.	Apply	2	2,5,9,10
4	Develop the conservation strategies for sustainability of species.	Create	2	3,5,7,9,10

TEXT BOOKS:

1. 1. M. W. Strickberger, “Evolution”, 1st edition, Jones and Bartlett, 1990.
2. S.Freeman and J.C.Herron, “Evolutionary analysis”, 1st edition, Prentice Hall, 2004

REFERENCE BOOKS:

1. Masatoshi Nei, Sudhir Kumar, “Molecular Evolution and Phylogenetics”, 1st edition, Oxford University Press, 2000.
2. Emmanuel Paradis, “Analysis of Phylogenetics and Evolution with R”, 2nd edition, Springer, 2011.
3. Ming-Hui Chen, Lynn Kuo, Paul O. Lewis, “Mathematical and Computational Biology Bayesian Phylogenetics: Methods, Algorithms, and Applications”, 1st edition, Chapman and Hall/CRC, 2014.

IV

YEAR

BIOINFORMATICS

B.Tech.

I SEMESTER

22BI401	-	Next Generation Sequencing
22BI402	-	Systems Biology
	-	Department Elective – 5
	-	Department Elective – 6
	-	Department Elective – 7
	-	Department Elective – 8

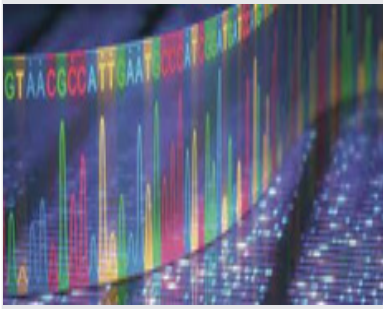
II SEMESTER

22BI403	-	Internship / Project Work

COURSE CONTENTS

I SEM & II SEM

22BI401 NEXT GENERATION SEQUENCING



source: https://www.labmanager.com/product-focus/the-third-wave-of-next-generation-sequencing-22898

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology, Algorithms in Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with the sequencing of genomic DNA using NGS tools. It also emphasizes applications in gene expression and exploration of sequencing genomic data.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

OVERVIEW OF SEQUENCING TECHNOLOGIES

Overview of model sequencing technologies, Sanger Sequencing, Next Generation sequencing platforms, Whole genome sequencing, Next generation sequencing data analysis: Data acquisition, base calling, Quality of sequencing data, Read mapping, genome assembly. Structural and functional annotation of genomes, Statistics and algorithms used in different steps in data analysis.

UNIT-2 **15L+0T+10P=25 Hours**

TECHNOLOGIES FOR TRANSCRIPTOMICS AND REGULATORY GENOMICS

Chip-seq analysis, Peak-finding, Motif discovery, RNA-seq analysis, Differential gene expression analysis, Exome sequencing and analysis.

PRACTICES:

- Exploring genomic data using different NGS sequencing Platforms.
- Analysis of DNA sequence data from databases.
- Explore various NGS resources, tools and databases for genomic data analysis.
- Performing whole genome sequencing and exome sequencing.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

SOFTWARE AND PIPELINES FOR NGS DATA ANALYSIS

Chip-seq analysis Piplines. RNA-seq analysis pipelines. Software used for assembly and differential gene analysis. Basics of Genome Browsers. Annotation pipelines.

UNIT-2 **15L+0T+10P=25 Hours**

GENOME SEQUENCING AND APPLICATIONS IN GENETICS STUDIES

Algorithms and application in studying regulation of gene expression. Emerging technologies of single-cell gene expression analysis. Metagenomics. Variant detection. Time series analysis. Pathway Analysis

.**PRACTICES:**

- Galaxy usage for analyzing NGS datasets.
- Assembling NGS data using Velvet.
- Perform gene ontology and pathway analysis.
- Identification of variants from tumor and normal sample pairs.
- Mapping and molecular identification of phenotype-causing mutations.

SKILLS:

- ✓ *Genomic data analysis obtained from different sequencing platforms*
- ✓ *Identifying gene expression levels from RNA and DNA sequencing data*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply Next Generation Sequencing tools in healthcare.	Apply	1	1,2,5,6,9,10
2	Analyze the various platforms in NGS.	Analyze	1	2,4,5,9,10
3	Apply the tools and techniques in NGS data analysis.	Apply	2	1,4,5,9,10
4	Evaluate the GWAS using NGS.	Evaluate	2	3,4,5,9,10

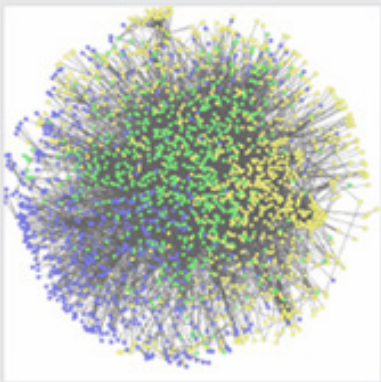
TEXT BOOKS:

1. Megahed Mohammad, “Genomic Data Analysis”, 2nd edition, LAP Lambert Academic Publishing, 2013.
2. Noam Shomrom, “Deep Sequencing Analysis” 1st edition, Springer, 2021.

REFERENCE BOOKS:

1. JM Bower and H Bolouri, “Computational modeling of genetic and biochemical networks”, MIT Press, 1st edition, 2005
2. Fall, C.P., Marland, E.S., Wagner, J.M., Tyson, J.J, “Computational Cell Biology”, Springer,1st edition, 2002.
3. Choi Sangdun, “Introduction to System Biology”, Humana Press/Trtowa/New Jersey, 1st edition, 2010.

22BI402 SYSTEMS BIOLOGY



source: https://irp.nih.gov/catalyst/v19i6/systems-biology-as-defined-by-nih

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biological Databases, Biochemistry and Enzymology, Algorithms in Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with applications of computer modelling and simulation of biological macro molecules. The targeted areas are protein and nucleic acids structure modelling, structure-based drug design, intermolecular interactions and binding.

MODULE-1

UNIT-1 **9L+0T+6P=15 Hours**

CONCEPTS OF BIOLOGICAL NETWORKS

Quantum Types of graphs; Applications of graph theory in construction of biological network; Structural Properties of Biological Networks; Analysis of centrality parameters in interaction Networks; Signal Transduction and Gene Networks; Protein–protein interaction networks; Gene regulatory networks.

UNIT-2 **15L+0T+10P=25 Hours**

MODELLING OF BIOLOGICAL SYSTEMS

Kinetic Modelling- Cellular Network reconstruction and Static Modelling - Construction and verification of kinetic models- introduction to DBsolve - Enzyme Kinetics modelling

.**PRACTICES:**

- Genomic tools for analyzing transcriptional regulatory networks.
- Target gene identification using gene enrichment analysis.
- Diseased gene identification using GeneCards and Entrez Gene.
- Identification of molecular biomarkers using MarkerDB.

MODULE-2

UNIT-1 **9L+0T+6P=15 Hours**

FLUX ANALYSIS

Flux Balance analysis (FBA); Applications in Biological systems; FBA in studying biochemical networks; Metabolic flux analysis.

UNIT-2 **15L+0T+10P=25 Hours**

METABOLIC MODELLING

Genome Annotation through knowledge of Metabolic Pathways, Organism Specific Metabolic Pathways, Metabolic network simulation, Metabolic Control Analysis & Engineering of Metabolic Pathways.

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SKILLS:

- ✓ *Design oscillatory genetic networks.*
- ✓ *Study of the interactions between the components of biological systems.*
- ✓ *Study of Stochastic modeling, Network modeling, and analysis*

PRACTICES:

- Database analysis for protein-protein interaction.
- Microarray dataset analysis.
- Designing protein interaction through cell designer.
- Functional protein interaction network using STRING.
- Systematic analysis of genome information using MIPS.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse genomics data to visualize and construct biological networks.	Analyse	1	2,4,5,6,9,10
2	Analyse the enzyme activity data using Kinetic modelling approach.	Analyse	1	2,4,5,9,10
3	Apply flux balance analysis of biological systems to identify optimal reaction flux distributions.	Apply	2	1,5,6,9,10
4	Evaluate the workflow for mathematical modelling of subcellular metabolic pathways.	Evaluate	2	1,3,5,7,9,10

TEXT BOOKS:

1. 1. Dokholyan, Nikolay, “Computational Modeling of Biological Systems: From Molecules to Pathways” Springer-Verlag New York, 1st edition, 2012.
2. Klipp E Wolfran L, “System Biology: A Text Book” Wiley-VH Verlag Gmbh; 1st edition, 2016.

REFERENCE BOOKS:

1. JM Bower and H Bolouri, eds, “Computational modeling of genetic and biochemical networks”, MIT Press, 1st edition, 2005.
2. Fall, C.P., Marland, E.S., Wagner, J.M., Tyson, J.J, “Computational Cell Biology”, Springer, 2nd edition, 2002.
3. Alon Uri, “Introduction to Systems Biology: Design Principles of Biology Circuits” Chapman & Hall/CRC/, 1st edition , 2007.

DEPT.
ELECTIVES

B.Tech.

COURSE CONTENTS

I SEM & II SEM

BIOINFORMATICS

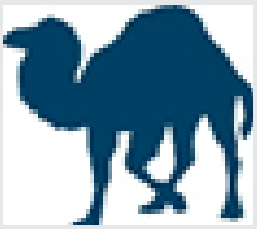
ODD SEMESTER

22BI801	-	Bioperl (M)
22BI802	-	Bioprocess Economics, Modeling and Simulations
22BI803	-	Clinical Data Management
22BI804	-	Expression Data and Image Analysis
22BI805	-	Health Analytics
22BI806	-	Neural Networks
22BI807	-	Probiotics and Food Microbiology
22BT803	-	Bioenergetics
22BT805	-	Biopharmaceutical Technology
22BT807	-	Genomics and Proteomics
22BT809	-	Metabolic Engineering
22BT815	-	Vaccinology
22BT819	-	Computer-Aided Drug Design (M)
22BT822	-	Health Informatics (M)
22BT828	-	Regulatory affairs and clinical trails

EVEN SEMESTER

22BI808	-	Biological Big Data Management and Analytics
22BI809	-	Cheminformatics and QSAR
22BI810	-	Good Laboratory Practices
22BI811	-	Synthetic biology (M)
22BT801	-	3D Bioprinting
22BT804	-	Bioethics and Intellectual Property Rights (M)
22BT810	-	Phage Display
22BT811	-	Phytopharma
22BT813	-	Plant Tissue Culture and Transgenics
22BT817	-	Biosensors

22BI801 BIOPERL



source: https://cdnlogo.com/logo/perl-programming-language_42804.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: C Programming.

COURSE DESCRIPTION AND OBJECTIVES:

Acquire knowledge of basic programming concepts in Perl with biology. Acquire skills in shell scripting and programming with Unix internals. Acquire knowledge of shell scripting. Acquires knowledge of file processing using Unix.

MODULE-1

UNIT-1 **6L+0T+6P= 12 Hours**

BIOLOGY AND COMPUTER SCIENCE

The organization of gene structure, DNA and protein sequences, Getting started with Perl - a low and long learning curve, Perl benefits, installing Perl on your computer, how to run Perl programs in the command line

UNIT-2 **10L+0T+10P= 20 Hours**

CELLULAR COMMUNICATION

The programming process, Sequences, Types of operators, Variables, representing sequence data, A program to store a DNA sequence, Concatenating DNA fragments, transcription - DNA to RNA, Using the Perl documentation, Calculating the reverse complement in Perl, Files, and arrays, Reading proteins from files, Scalar variables, List context.

.**PRACTICES:**

- Aligning of nucleotide sequences using Local Blast.
- Create a Perl script to search for genes from Genscan.
- Protein Sequence Generation using Perl program.
- Write a Perl program to count start and stop codons in a sequence.
- Calculate the reverse complement of the DNA Sequence using Perl.
- Concatenate two DNA Fragments.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

MOTIFS, LOOPS, SUBROUTINES, AND BUGS

Motifs and loops - flow control, code layout, finding Motifs, counting nucleotides, exploring strings into arrays, operating on strings writing to files. Subroutines and Bugs: Subroutines, Scoping and subroutines, Command-line arguments and arrays, passing data to subroutines, modules, and libraries of subroutines, fixing bugs in your code.

UNIT-2 **10L+0T+10P=20 Hours**

RANDOMIZATION AND GENETIC CODE

Random number generators, a program using randomization, a program to simulate DNA mutation, generating random DNA, Analyzing DNA Hashes, Data structures and algorithms for Biology, the genetic code, Translating DNA into proteins, Reading DNA from files in FASTA format, Reading frames

SKILLS:

- ✓ *Installation and running of Perl scripts in various environments*
- ✓ *Develop own Perl scripts to analyze biological sequences.*
- ✓ *Design Perl script to perform phylogenetic analysis.*
- ✓ *Reading DNA and Protein sequences from files in FASTA format*

.**PRACTICES:**

- Perl script to perform transcription and translation
- Write a Program to simulate DNA Mutation using Perl.
- Write a code to check file extensions using Perl.
- Compute the total and average length of the proteins in these files with the Bioperl module.
- Aligning multiple sequences with Clustalw.pm and TCoffee.pm.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply programming concepts and utilities of UNIX for writing perl scripts.	Apply	1	1,2,9,10
2	Analyze Perl scripts and modify them to handle biological sequence file formats.	Analyze	1	2,4,9,10
3	Develop Perl programs using subroutines to solve biological problems.	Evaluate	2	3,6,9,10
4	Create a Perl package comprised of modules to extract, and analyze the biological data.	Create	2	3,4,9,10

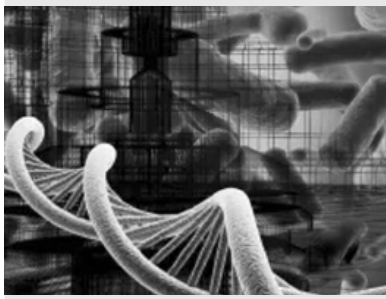
TEXTBOOKS:

1. Tisdall, James, “Beginning Perl for Bioinformatics: an introduction to Perl for Biologists “, O’Reilly, 1st edition, 2001.
2. S.Sai Giridhar and S.Krupanidhi “Introductory Workbook on Perl for Biology Students”, Biology-Online.org, 2nd edition, 2009.

REFERENCE BOOKS:

1. Tisdall, James, “Mastering Perl for Bioinformatics: Perl Programming for Bioinformatics” O’Reilly, 1st edition, 2003.
2. Dwyer, Rex A, “Genomic Perl: From Bioinformatics Basics to Working Code”, Cambridge University Press, 2nd edition, 2003.
3. Brian D Foy, “Learning Perl 6”, O’Reily, 1st edition, 2018.

22BI802 BIOPROCESS ECONOMICS, MODELING AND SIMULATIONS



Source: Bioprocess Engineering by Kim Gail Clarke - Ebook | Scribd

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Bioprocess Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

The objective of the course is to model bioprocess behaviour, predict output parameters using simulation techniques and optimize the overall cost of integrated bioprocess operation. It also helps to model growth kinetics in various modes of operation of fermenter.

MODULE -1

UNIT-1 **6L+6T+0P=12 Hours**

MATHEMATICAL MODELS

Basics of mathematical models, Principles of formulation, Fundamental laws, Continuity equations, Energy equations, Equations of motions, Transport equations, Equation state, Equilibrium, Chemical kinetics and bio-kinetic, Model structure and complexity, Rate models.

UNIT-2 **10L+10T+0P=20 Hours**

FERMENTATION PROCESS

Modelling of fermentation processes, Structured and unstructured models, Design aspects of bioprocess economics, Modelling of bioreactors, Immobilized enzyme bioreactors, Plug flow reactor and continuous stirred tank fermenter.

TRANSITIONS:

- Review on parameters need to consider while modeling fermentation processes.
- A report on optimization of economics of bioprocesses.
- Design a model on bioreactor.
- Design a model on immobilized enzyme bioreactors.

MODULE -2

UNIT-1 **6L+6T+0P=12 Hours**

BIOPROCESS CONTROL

On-line data analysis for measurement of important physico - chemical and biochemical parameters, State and parameteres estimation techniques for biochemical processes.

UNIT-2 **10L+10T+0P=20 Hours**

SOFTWAREPACKAGESFORSIMULATION

Software packages for simulation of bioprocesses - MATLA B and BERKELEY - MADONNA, Simulation of bio processes using models from literature sources.

SKILLS:

- ✓ *Modeling of fermentation process.*
- ✓ *Modeling of growth kinetics in batch, fed-batch and continuous fermenter.*
- ✓ *Simulation of bioprocesses using MATLAB and BERKELEY-MADONNA softwares.*

PRACTICES:

- Model microbial fed-batch growth kinetics in MATLAB.
- Model microbial continuous growth kinetics in MATLAB.
- Model microbial batch growth kinetics in BERKELEY - MADONNA.
- Model microbial fed batch growth kinetics in BERKELEY - MADONNA. .

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply principles of modelling to fermentation processes.	Apply	1	1,2,4,9,10
2	Analyze bioreactor models.	Analyze	1	2,5,6,9,10
3	Design simulation techniques using software-packages.	Create	2	3,5,9,10
4	Analyze economics of bioprocesses.	Analyze	1	2,4,9,10,11

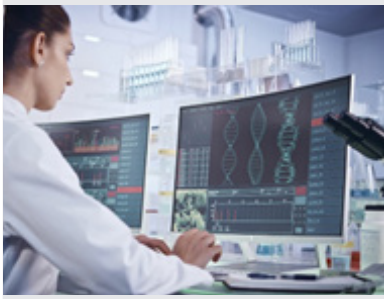
TEXT BOOKS:

1. Bhanvase BA, Ugwekar RP, “Process Modeling, Simulation, and Environmental Applications in Chemical Engineering”, 1st edition, CRC Press, 2016.
2. Yang ST, “Bioprocessing for value-added products from renewable resources: new technologies and applications”, 1st edition, Elsevier, 2011.

REFERENCEBOOKS:

1. Villadsen J, Nielsen J, Lidén G, “Bioreaction engineering principles”, 1st edition, Springer Science & Business Media, 2011.
2. Bailey JE, Ollis DF, “Biochemical engineering fundamentals”, 2nd edition, McGraw-Hill, 2018.
3. Michael L. Shuler, FikretKargi, “Bioprocess Engineering: Basic Concepts”, 2nd Edition, Pearson, 2002.

22BI803 CLINICAL DATA MANAGEMENT



source: https://premierinc.com/images/newsroom/2022-Medical_Data.jpg

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of biology, Health inform.

COURSE DESCRIPTION AND OBJECTIVES:

Clinical data management (CDM) is the process of collecting and managing research data in accordance with regulatory standards to obtain quality information that is complete and error-free. The goal is to gather as much of such data for analysis as possible that adheres to federal, state, and local regulations.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION

Audience and scope, other sources of knowledge, Fundamental concepts, Types of outcome measures and understanding clinical research analysis. Clinical reasoning based on the case history, Statistical reasoning emphasizes inference based on designed data production, Clinical and statistical reasoning converge in research, defining clinical trials- Formal analysis, Clinical trials as science, Practicalities of usage.

UNIT-2 **10L+0T+10P=20 Hours**

CLINICAL TRIALS ETHICS

Introduction-science and ethics share objectives, Equipoise and uncertainty, Duality-clinical trials sharpen, the Issue, A gene therapy tragedy illustrates duality, The hippocratic tradition - Proscribe clinical trials, Historically derived principles of ethics, Contemporary foundational principles, methodologic reflections, professional conduct.

PRACTICES:

- Data Entry
- Data Validations
- Query Management
- Database lock
- Validation procedures
- Data Clustering using Bayesian tool
- Likelihood Test for data analysis
- Modeling Longitudinal Data.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

CONTEXTS FOR CLINICAL TRIALS

Introduction-ways to learn about trials in a given context, Issues of context, drugs, devices, prevention-The prevention versus therapy dichotomy is overworked, Vaccines and biologicals, A perspective on risk– benefit, Methodology and framework for prevention trials, Complementary and alternative medicine, A brief view of clinical trial contexts.

SKILLS:

- ✓ *Data Entry & Data Validations*
- ✓ *Likelihood Test for data analysis*
- ✓ *Data Clustering using Bayesian tool*

UNIT-2 **10L+0T+10P=20 Hours**

STATISTICAL PERSPECTIVES

Introduction- differences in statistical perspectives, frequentist, bayesian, likelihood, after thoughts, modeling longitudinal data, Evaluation of diagnostic tests

.**PRACTICES:**

- Clinical data Set-Up
- GLIBS – data extraction methods and analysis
- Data Entry
- Data Validations
- Query Management
- Clinical data Set-Up
- GLIBS – data extraction methods and analysis. .

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Evaluate the principles and generalizations already learned about science and technology to new problems and situations	Evaluate	1	2,6,7,9,10
2	Apply and Learn terms and facts of Clinical trials	Apply	1	2,4,9,10
3	Analyze the concepts and theories of Data management	Analyze	2	1,2,4,9,10
4	Recognize the learned concepts and to apply them in maintaining health and clinical data resources	Apply	2	3,6,9,10

TEXT BOOKS:

1. Piantadosi S, “Clinical Trials: a Methodologic Perspective”, JohnWiley and Son, New York, 2nd edition, 2017.
2. Allan H, “A Concise Guide to Clinical Trials”, A John Wiley and Sons, Ltd., New York, 1st edition, 2019.

REFERENCE BOOKS:

1. Partrick P, “Clinical Epidemiology practice and methods”, Humana press, New York, 1st edition, 2019
2. Friedman L.M, Furberg C, and DeMets D.L, “Fundamentals of Clinical Trials”, Springer, New York, 3rd edition, 1998.
3. Chow S-C and Liu J-P, “Design and Analysis of Clinical Trials”, JohnWiley and Son, New York, 2nd edition, 2014.
4. Stephanie G, Jacqueline B, and John C, “Clinical Trials in Oncology”, CRC press, USA 2nd edition, 2012.

22BI804 EXPRESSION DATA AND IMAGE ANALYSIS

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology.

COURSE DESCRIPTION AND OBJECTIVES:

This course covers the topics relating to raw microarray data and analysis which have to be transformed into gene expression matrices—tables for characterizing expression level of particular gene.

MODULE-1

UNIT-1 **6L+0T+6P= 12 Hours**

INTRODUCTION

Types of microarrays, Microarray technologies, Using microarray, Microarray standard databases: LIMS, MGED, MAGE, Microarray sequence databases - primary and secondary databases.

Overview of Microarray Experiments and Image Analysis: Microarray chip manufacture, steps in microarray experiment, Image processing- Microarray data cleaning and preprocessing, Data normalization.

UNIT-2 **10L+0T+10P= 20 Hours**

IMAGE FEATURE EXTRACTION

Identifying the positions of the features – Identifying the background pixel normalization, Data cleaning and transformation – Linear and non-linear regression of log ratio against average density.

PRACTICES:

- Gene expression analysis by GEO of NCBI
- Functional genomics experiments from Array Express of EBI
- Data analysis through SMD
- Gene Expression Database
- Data analysis and visualization
- Normalization of data

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

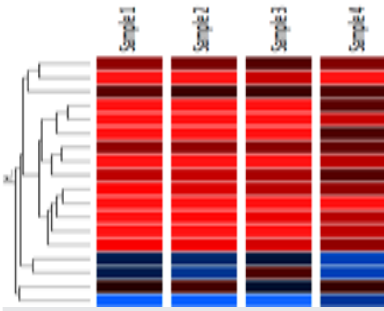
ANALYSIS OF DIFFERENTIALLY EXPRESSED GENES

Statistical inference, Hypothesis test, fold change methods, parametric test- paired t- Test, Unpaired t-Test, Non- parametric tests- classical and bootstrap analysis, ANOVA- One way and Two way.

UNIT-2 **10L+0T+10P=20 Hours**

GENE BASED ANALYSIS

Proximity measurement for gene expression data - Euclidean distance, Correlation Coefficient, Partition Based approaches - K-means and its variation, SOM and its Extensions, model based clustering, Hierarchical approaches



source: https://www.ebi.ac.uk/training/online/courses/functional-genomics-ii-common-technologies-and-data-analysis-methods/biological-interpretation-of-gene-expression-data-2/ Image

SKILLS:

- ✓ *DEG analysis using microarray cancer data sets.*
- ✓ *Microarray data transformation and normalization*
- ✓ *Microarray for tracking epigenetic modifications*

.**PRACTICES:**

- Prediction Analysis for Microarrays
- Supervised learning software for genomic expression data mining
- Perform hierarchical clustering, self-organizing maps.
- Correlation analysis
- Analyzing gene co-expression networks built from microarray expression data
- Gene expression experiments in the context of biological pathways. .

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze microarray data sets and design simple gene regulatory networks for few genes and assess its performance.	Analyze	1	2.3,5,9,10
2	Analyze the three dimensional macromolecular structure using visualization software	Analyze	1	2,3,4,5,9,10
3	Apply statistical methods for biological data analysis.	Apply	2	1,2,4,5,9,10
4	Apply clustering based methods for genome wide analysis.	Apply	2	1,2,5,7,9,10

TEXT BOOKS:

1. Dov Stekel, ‘’Microarray Bioinformatics’’ Cambridge University Press”, 1st edition, UK, 2005.
2. Aidong Zhang, ‘’Advanced analysis of Gene expression microarray data’’, 2nd edition, World Scientific Publishing House, 2006.

REFERENCE BOOKS:

1. Pierre B, Wesley H, ‘’DNA microarrays and gene expression from experiments to data analysis and modeling’’, 1st edition, Cambridge University Press, 2002.
2. Wang, “Pattern Discovery in Biomolecular Data: Tools, Techniques and Applications”, 1st edition), Oxford University Press, 1999.
3. Muller U.R., Nicolau D.V., “Microarray Technology and Its Applications”,1st edition ,Springer, 2005.

22BI805 HEALTH ANALYTICS

source: https://www.scnsoft.com/blog/health-data-analytics-overview

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Clinical data management, Health informatics.

COURSE DESCRIPTION AND OBJECTIVES:

Healthcare analytics refers to the use of vast amounts of collected data to provide organizations with actionable insights. These insights are developed through analytical disciplines to drive fact-based decision-making. In turn, these decisions improve planning, management, measurement and learning.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO QUALITY IMPROVEMENT AND DATA ANALYTICS

Overview of Healthcare Analytics, Importance of data and data analytics to a healthcare organization, define health care data analytics, discuss how analytics can help transform health care. Introduction - Describe the data information, knowledge and wisdom hierarchy, List sources of health care data, Health data for quality and performance improvement, an organizational approach for effective use of data analytics, Describe the role of data governance.

UNIT-2 **10L+0T+10P=20 Hours**

CONCEPTS IN EHR AND MEDICAL RECORDS

Principles of Predictive Analytics, Definitions, Sub disciplines and professional organizations and activities, Major health informatics applications including electronic health records (EHR) and computerized physician order entry (CPOE), good clinical practices (gcp), eHealth applications

.**PRACTICES:**

- Collect the new forms of clinical information.
- Electronic Health Record analysis.
- Find the doctor using of information sources.
- How to apply Probability in health informatics data.
- Use truth tables in medical informatics data.
- Apply predicate calculus in medical bioinformatics

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

WORKING WITH DATA ANALYTICS

Basic statistical skills for data analysis, define common data types, define basic statistical terms, Recognize common patterns or distributions in statistics, Describe distributions using numerical measures such as mean, median and standard deviation, Identify common graphical representations of data including histograms, bar charts and scatterplots.

UNIT-2 **10L+0T+10P=20 Hours**

DATA ANALYTICS TOOLS AND TECHNIQUES

The creation and structure of datasets, an introduction to data warehousing and working with large databases, Natural Language Processing, retrieval process of public health and healthcare datasets, methods for descriptive analytics, and an introduction to SPSS, SAS and SAP for health data analytics

SKILLS:

- ✓ *Hospital Management*
- ✓ *Information systems*

.**PRACTICES:**

- Hospital Management and Information systems
- Statistical hypothesis testing in Medical informatics
- Clinical data management (an overview). .

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the basic concepts in data analytics	Apply	1	1,2,6,7,9,10
2	Apply the knowledge of analytics to predict health related information	Apply	1	1,2,4,9,10
3	Develop solutions to the community health and safety	Create	2	1,2,4,9,10
4	Evaluate the principles of predictive analysis and EHR.	Evaluate	2	3,6,9,10

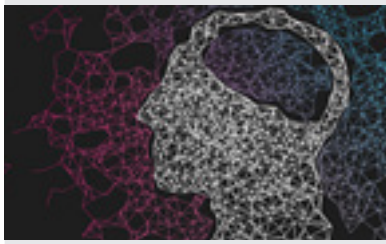
TEXT BOOK:

1. Shortliffe and Cimino, “Biomedical informatics: computer applications in health care and biomedicine”, Springer, 3rd edition, 2016.

REFERENCE BOOKS:

1. Mohan Bansal, “Medical Informatics- a primer”, 1st edition, Tata McGraw-Hill, New Delhi, 2013.
2. Edward H. Shortliffe, “Medical Informatics: Computer Applications in Health Care and Biomedicine”, 2nd edition, Springer, 2010.
3. Taylor Paul, “From Patient Data to Medical Knowledge: The Principles and Practice of Health Informatics”, 2nd edition, Blackwell Scientific Publishing, 2016.

22BI806 NEURAL NETWORKS



source: https://bernardmarr.com/deep-learning-vs-neural-networks-whats-the-difference/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Algorithms in Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

Upon the completion of the course the student will be able to grasp the neural networks for pattern classification and association. Acquire the basic concepts of competition based neural nets. Comprehend architecture and algorithms for adaptive resonance theory. Apply back propagation of multilayer neural nets.

MODULE-1

UNIT- 1 **6L+0T+6P=12 Hours**

LEARNING AND GENERALIZATION IN SINGLE LAYER PERCEPTIONS

Biological neurons and Neural Networks; Artificial Intelligence (AI) - artificial neurons, networks of artificial neurons, concept of perceptrons, Artificial Neural Networks (ANN). Hebbian learning; Gradient descent learning; Generalized delta rule; Practical considerations - learning in single-layer, multilayer perceptrons; Back-propagation; Learning with momentum; Conjugate gradient learning.

UNIT- 2 **10L+0T+10P=20 Hours**

BIAS AND VARIANCE

Supervised and unsupervised learning - under- fitting and over-fitting, improving generalization.

.**PRACTICES:**

- Exercise for making Hypothesis and Model based on Probability theory.
- Application of Bayesian Theory on the designed Model.
- Application of Graph Theory for refining the Model.

MODULE-2

UNIT- 1 **6L+0T+6P=12 Hours**

APPLICATIONS OF PERCEPTRONS

Radial basis function networks - introduction, radial basis function networks, algorithms and applications; Committee machines; Applications of AI in medical and agriculture.

UNIT- 2 **10L+0T+10P=20 Hours**

SELF ORGANIZING MAPS

Fundamentals, Self-Organizing Maps (SOM), N-N clustering, Algorithms and applications, Learning vector quantisation.

PRACTICES:

- Exercise on the Best Model Selection Procedures.
- Designing of Model Based on Single Die.
- Exercise for writing algorithms for solving basic Bioinformatics Problem.

SKILLS:

- ✓ *Design of models.*
- ✓ *Use of AI based tools.*
- ✓ *Applying algo-rithms for model design*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply fundamental principles and techniques of neural network systems.	Apply	1	1, 2, 4,5,9,10
2	Analyze the performance of neural networks.	Analyze	1	2,4,6,9,10
3	Develop and train radial-basis function networks.	Create	2	2,3,6,9,10
4	Design single and multi-layer feed-forward neural networks.	Create	2	2, 7,9,10

TEXT BOOK:

1. Daniel Graupe, “Principles of Artificial Neural Networks”, 3rd edition, World Scientific Publishing Co. Pte. Ltd., 2013.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, “Introduction to Statistical Learning”, 1st edition, Springer, 2013.

REFERENCE BOOKS:

1. Raul Rojas, “Neural Networks: A Systematic Introduction”, 1st edition, Springer, 2013.
2. David W. Pearson, Nigel C. Steele and Rudolf F. Albrecht, “Artificial Neural Nets and Genetic Algorithms”, 2nd edition, Springer, 2012.

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22BI807 PROBIOTICS AND FOOD MICROBIOLOGY

source: https://www.nccih.nih.gov/health/probiotics-what-you-need-to-know

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology..

COURSE DESCRIPTION AND OBJECTIVES:

This course provides the knowledge on probiotics and prebiotics used in food products. It enables the students to analyze different microorganisms as starter cultures for the development of food products and also the bio-preservatives usage in control of food spoilage. In addition to these, it enlightens the novel strategies for controlling the food borne pathogens.

MODULE-1

UNIT- 1 **6L+0T+6P=12 Hours**

PROBIOTICS

Probiotic microorganisms; Safety of probiotic microorganisms; Characteristics of Probiotics for selection - Tolerance to additives, stability during storage and passage to intestinal sites, minimum effective dose; Maintenance of probiotic microorganisms; Prebiotics and gut microflora, Prebiotics and health benefits.

UNIT- 2 **10L+0T+10P=20 Hours**

HEALTH BENEFITS ASSOCIATED WITH PROBIOTICS

Probiotics and Prebiotics in-Prevention and treatment of gastrointestinal bacterial infection; Constipations; Hepatic encephalopathy; Chronic urinary tract infection; Antitumor, antihypertensive and cholesterol level.

.**PRACTICES:**

- Culturing of Probiotic organisms.
- Probiotic characterization - Acid and bile salt tolerance.
- Cell adhesion assay.
- Auto aggregation and Coaggregation assay.
- Antibiotic susceptibility assay

MODULE-2

UNIT- 1 **6L+0T+6P=12 Hours**

FOOD MICROBIOLOGY

Characteristics of predominant microorganisms in food; Sources of food spoilage microorganisms; Lactic acid bacteria and food fermentations; Starters cultures; current trends in lactic starter for industrial applications; Food preservation techniques; Application of bacteriocins in foods.

UNIT- 2 **10L+0T+10P=20 Hours**

FOOD SAFETY

Current trends in food safety; emerging pathogens; Ecology and survival strategy of pathogens in foods; Control of food-based pathogens, concepts in food toxicology; Food borne toxins; Food quality and safety management.

SKILLS:

- ✓ *Design of models.*
- ✓ *Use of AI based tools.*
- ✓ *Applying algorithms for model design*

PRACTICES:

- Isolation and characterization of probiotic bacteria from fermented foods and diary effluents.
- Development of probiotics as starter cultures for food products.
- Produce bio-preservatives from probiotic bacteria.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the probiotics and prebiotics in food products.	Analyze	1	1,2,4,9,10
2	Apply the probiotics and prebiotics in health and disease control.	Apply	1	1,2,6,9,10
3	Identify the strains responsible for food spoilage.	Analyze	2	2,4,9,10
4	Design strategies for control of food borne pathogens and toxins.	Creating	2	3,4,6,7,9,10

TEXT BOOKS:

1. Lee YK, Salminen S, “Handbook of probiotics and prebiotics”, 1st edition, John Wiley & Sons, 2009.
2. Gibson GR, Roberfroid M, “Handbook of prebiotics”, 2nd edition, CRC Press, 2008.

REFERENCE BOOKS:

1. Ray B, Bhunia AK, “Fundamental food microbiology”, 1st edition, Boca Raton: CRC press, 2001.
2. Matthews KR, Kniel KE, Montville TJ, “Food microbiology: an introduction”, 2nd edition, John Wiley & Sons, 2017.
3. William C Frazier, Dennis C Westhoff, Vanitha NM, “Food Microbiology”, 5th edition, Mc Graw Hill Education India, 2014.

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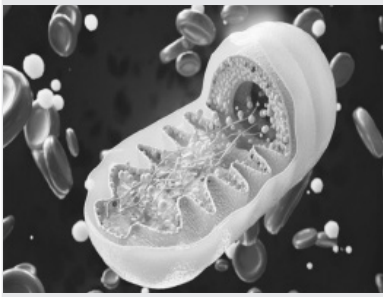
22BT803 BIOENERGETICS



Source: https://creatingbalancedhealth.com/what-is-bioenergetics-an-essential-guide-to-everything-you-need-to-know/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Biochemistry and Enzymology.

COURSE DESCRIPTION AND OBJECTIVES:

The course enables in depth study on the relationship between energy and living systems. The aim of the course is to provide knowledge about biosynthesis and principles of classical thermodynamics of cellular systems.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

CHEMIOSMOTIC ENERGY TRANSDUCTION

Morphology of energy - transducing membranes, chemiosmotic concepts; Ion transport across energy-conserving membranes, bilayer-mediate transport, protein-catalyzed transport, swelling and the coordinate movement of ions across membranes.

UNIT-2 **10L+10T+0P=20 Hours**

QUANTITATIVE BIOENERGETICS

Gibbs energy and equilibrium, ΔG for the ATP hydrolysis and synthesis reactions, redox potentials, electron and hydrogen carriers, thermodynamics of electron transfer and membrane transport, diffusion potentials, donnan potentials, and surface potentials.

PRACTICES:

- A compilation on the efficiency of oxidative phosphorylation.
- Calculation of Gibbs free energy of cellular reactions.
- A review on permeability of ions.
- A report on diffusion potentials of physiologically important ions.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

ARCHITECTURE, CHEMICAL ACTIVITY OF MITOCHONDRIA

Sequence of electron carriers and sites of oxidative phosphorylation, ATP generation, heme and non-heme iron proteins, Thermodynamic considerations, oxidation-reduction electrodes, standard electrode potential, redox couples, phosphate group transfer potential, Respiratory controls, Theories of oxidative phosphorylation, uncouplers and inhibitors of energy transfer, ATP synthetase complex, ATP generation in bacterial system.

PRACTICES:

- Report on thermodynamics of oxidative phosphorylation.
- Review on mammalian and bacterial respiratory chains.

SKILLS:

- ✓ *Relating ATP and proton motive forces.*
- ✓ *Evaluating energy conversions in different organelles.*
- ✓ *Differentiating respiratory chains between plants and animals.*

UNIT-2 **10L+10T+0P=20 Hours**

CELLULAR BIOENERGETICS

Respiration in photosynthetic bacteria, electron transfer pathways in green plants, algae and cyanobacteria, bacteriorhodopsin, halorhodopsin and proteorhodopsin, ATP synthases and bacterial flagella rotary motors, Cellular bioenergetics-the cytoplasmic environment, mitochondrial monovalent ion transport, quantifying the mitochondrial proton current in intact cells, mitochondrial proton motive force in intact cells.

PRACTICES:

- Thermodynamics of photo systems.
- Compare impacts of electron leaks and proton leaks.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Evaluate bio-energetics of cellular reactions.	Evaluate	1	1,2,5,9,10
2	Calculate free energy changes of biological reactions.	Apply	1	2,3,5,9,10
3	Develop energy balance equation in ETC.	Create	2	2,3,4,5,6,9,10
4	Analyze metabolic pathways involved in bioenergetics.	Analyze	2	2,4,5,7,9,10

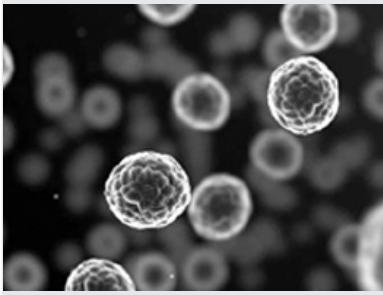
TEXT BOOKS:

1. L Ernster, “Bioenergetics”, 1st edition, Elsevier, 2011.
2. David G Nicholls and S J Ferguson, “Bioenergetics”, 4th edition, Academic, 2013.

REFERENCE BOOKS:

1. James Hemp, Robert B. Gennis (auth.), Gunter Schafer, Harvey S. Penefsky, “Bioenergetics: Energy Conservation and Conversion”, 1st edition, Springer-Verlag Berlin Heidelberg, 2008.
2. David Nicholls, Stuart Ferguson, “Bioenergetics”, 3rd edition, Elsevier, 2002.
3. Vladimir P. Skulachev, Alexander V. Bogachev, Felix O. Kasparinsky (auth.), “Principles of Bioenergetics”, 1st edition, Springer-Verlag Berlin Heidelberg, 2013.

22BT805 BIOPHARMACEUTICAL TECHNOLOGY



Source: https://www.prweb.com/releases/advancements_series_to_explore_breakthroughs_in_biopharmaceutical_technology/prweb18382243.htm

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers information on sources of drugs, pharmacodynamics and pharmacokinetics. It provides the knowledge on production and applications of biopharmaceuticals, drug delivery systems and drug manufacturing. Further it emphasizes on recombinant therapeutic products and its applications.

MODULE-1

UNIT-1 **6L+6T+0P=12Hours**

SOURCES OF DRUGS

Plant, animals, microbes and minerals, Routes of drug administration, Different dosage forms, Manufacturing facilities, Recent advances in the manufacture of drugs using r-DNA technology, Structure based denovo ligand design, Drug discovery.

UNIT-2 **10L+10T+0P=20 Hours**

MECHANISM OF DRUG ACTION

Physicochemical principles, Pharmacodynamics - mechanism of drug action, drug receptors-structural and functional families, Pharmacokinetics-drug absorption, factors that affect the absorption of drugs, distribution of drugs, biotransformation of drugs, bioavailability of drugs.

PRACTICES:

- Report on FDA approved drugs from Plants, animals and microbes.
- Analysis on reported efficacy of pharmaceutical drugs for blood pressure, cancer and diabetes.
- Identify commercially used recombinant strains for biopharmaceuticals.
- Report on active pharmaceutical ingredients/key intermediates.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

THERAPEUTIC PROTEINS

Production of therapeutic proteins, hormones, cytokines-interferons, interleukins, TNF, Haemopoietic growth factors, Blood products and nucleic acid therapeutics.

UNIT-2 **10L+10T+0P=20 Hours**

BIOMATERIALS & SUSTAINED DRUG DELIVERY

Controlled and sustained delivery of drugs, Biomaterial for the sustained drug delivery; Liposome mediated drug delivery, hydrogel biomaterials, gene/nucleic acid delivery; cells as drugs and drug delivery systems.

PRACTICES:

- Preparation of a pie chart on the available therapeutic drugs.
- Development of flow chart for the industrial production of recombinants.
- Report on biomaterials in sustained drug delivery.

SKILLS:

- ✓ *Formulation of dosage of bio-pharmaceuticals.*
- ✓ *Implementation of good manufacturing practices in industries.*
- ✓ *Development of production process for therapeutic proteins.*

- Review on cells and nucleic acids as delivery systems.

.COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the sources of drugs, different dosage forms and routes of drug administration.	Analyze	1,2,4	2,3,4,6,9,10
2	Assess the pharmacodynamic and pharmacokinetic mechanisms for biopharmaceuticals using in-silico tools.	Analyze	3,5	2,4,6,9,10
3	Adopt Good Manufacturing Practices (GMP) for production, analysis and formulation of biopharmaceuticals.	Apply	3,4	3,4,6,7,9,10
4	Develop process flowsheets for production of therapeutic proteins.	Create	2,3,4	3,6,7,9,10
5	Evaluate and analyze the biomaterials used for different drug delivery systems.	Evaluate	3,4	3,6,7,9,10

TEXT BOOKS:

1. L Lachman, H A Lieberman and J L Kanig, “Theory and Practice of Industrial Pharmacy”, 3rd edition, Varghese, 2001.
2. G Walsh, “Biopharmaceuticals: Biochemistry and Biotechnology”, 2nd edition, Wiley, 2005.

REFERENCEBOOKS:

1. M Gibaldi, “Biopharmaceutics and Clinical Pharmacokinetics”, 1st edition, Pharma Book Syndicate, 2006.
2. J P Remington, “Remington-The science and practice of pharmacy”, 2nd edition, publisher, 2006.
3. K D Tripathi, “Essentials of Medical Pharmacology”,6th edition, Jaypee, 2006.

22BT807 GENOMICS AND PROTEOMICS

Source: https://www.townscript.com/e/genomics-proteomics-molecular-biology-training

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology, Genetic Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

To acquaint the students with the knowledge of various tools available for analyzing genomes and proteomes. And also, to throw light on genomic and proteomic approaches utilized for various applications.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO GENOME

Classification of genomics, organization and structure of genomes-genome size, Sequence complexity, Introns and exons, Chromosome micro dissection and its applications.

UNIT-2 **10L+0T+10P=20 Hours**

GENOME ANNOTATION METHODS

Genome annotation, traditional routes of gene identification, detecting open reading frames (ORFs), tools for finding genes, approaches for expression profiling, Determining gene function by sequence comparison and through conserved protein structure.

PRACTICES:

- Insilicodetermination of introns and exons in a given sequence.
- Determining ORF in a given nucleotide sequence.
- Analyzing the function of gene by insilicomeans.
- Sequence analysis by BLAST and identification of cSNPs.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

MICROARRAYS

Microarrays: Importance, types, designing microarray experiment and applications, Next generation sequencing- comparison of various next generation sequencing approaches and its applications, Insights from genome sequencing of various species.

UNIT-2 **10L+0T+10P=20 Hours**

PROTEOMICS

Mining proteomes, detecting proteins in polyacrylamide gels, Two-dimensional polyacrylamide gel electrophoresis- procedure, image analysis, mass spectrometry, MALDI-ToF, Applications of proteomics.

PRACTICES:

- Amplification of a gene and sub-cloning into vectors.
- Prokaryotic expression of genes.
- Analyzing the solubility of proteins.
- Determining the biological activity of a given protein.

SKILLS:

- ✓ *Identification of exons and introns in genes of different species.*
- ✓ *Identification of cSNPs between any two genes pertaining to two different breeds of species.*
- ✓ *Analysis of gene expression profiles and protein sequences*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Adopt various tools for annotation of genomes and proteomes.	Apply	1	1, 2, 4,5,9,10
2	Analyze gene expression patterns using NGS and biochip technology.	Analyze	1	2,4,5,9,10
3	Apply analytical techniques for protein-separation and identification.	Apply	2	2,3,6,9,10
4	Integrate the concepts of genomics and proteomics in various biotechnological applications towards sustainable development.	Design	2	2,3,7,9,10

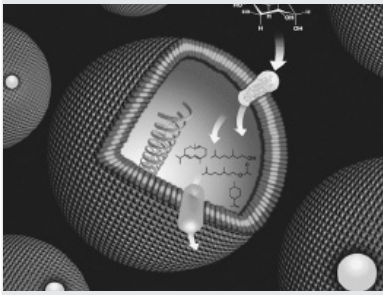
TEXT BOOKS:

1. S B Primrose and R M Twyman, “Principles of Genome Analysis and Genomics”, 7th edition, Blackwell, 2014.
2. S Sahai, “Genomics and Proteomics, Functional and Computational Aspects”, 2nd edition, Springer, 2013.

REFERENCE BOOKS:

1. Andrezej K Konopka and James C Crabbe, “Compact Hand Book-Computational Biology”, 3rd edition, CRC Press, 2004.
2. Pennington & Dunn, “Proteomics from Protein Sequence to function”, 1st edition, Garland Science, 2002.
3. Lesk AM, “Introduction to genomics”, Oxford University Press, 3rd edition, 2017.

22BT809 METABOLIC ENGINEERING



Source: https://newscenter.lbl.gov/2010/12/02/metabolic-engineering/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biochemistry and enzymology.

COURSE DESCRIPTION AND OBJECTIVES:

Metabolic engineering is an emerging field of biotechnology / bioprocess engineering which aims towards purposeful modification of cellular (metabolic, gene regulatory, and signalling) processes/networks to achieve desirable goals such as enhanced production of metabolites including pharmaceuticals, biofuels and biochemicals and other biotechnology products. The objective of this course is systematic analysis of metabolic and other pathways with molecular biological techniques to improve cellular properties for the product improvement by designing and implementing rational genetic modifications.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

CELLULAR METABOLISM

Overview of cellular metabolism, Fueling Metabolism, Supply of biomass precursors, Anabolism and anaplerosis, Methods employed to study metabolism and pathway analysis, Importance of metabolic engineering, material balances and data consistency.

UNIT-2 **10L+0T+10P=20 Hours**

METABOLIC NETWORKS

Coordination of metabolic reactions, Metabolic regulation network at enzyme level and whole cell level, Metabolic strategies and regulation, Integration of metabolic pathways, Comprehensive models for cellular reactions, Metabolic pathway synthesis.

PRACTICES

- Create a comprehensive model using stoichiometry.
- Create a comprehensive model using reaction rates.
- Create a comprehensive model using dynamic mass balance.
- Develop a simple black box model.
- Synthesize a metabolic pathway based on a validated template.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

METABOLIC FLUX ANALYSIS

Theory, Determination of flux by isotope labelling - Metabolic control analysis-control coefficients and summation theorems, Bottom up and Top-down approaches.

UNIT-2 **10L+0T+10P=20 Hours**

FLUX ANALYSIS AND NETWORKS

FCC determination, Grouping of reactions- gFCC and identification of independent pathways, Bottom up and Top-down approaches-case study, Optimization of flux amplification-consistency tests and experiment validation.

SKILLS:

- ✓ *Exploiting black box model to evaluate data consistency.*
- ✓ *Ascertain the viability of a synthesized metabolic pathway.*
- ✓ *Grouping of reactions via metabolic control analysis*

PRACTICES:

- Create a group of reactions from known pathways.
- Identify an independent pathway.
- Establish the control distribution in a metabolic network through bottom-up approach.
- Establish the control distribution in a metabolic network through top-down approach.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Establish data consistency using black box model.	Analyze	1	1, 4, 5,9,10
2	Develop a comprehensive model for a balanced cellular reaction.	Create	1	2, 3, 5,9,10
3	Synthesize metabolic pathways.	Analyze	1	3, 4,9,10
4	Determine metabolic flux using isotope labelling.	Apply	2	1, 4, 5,9,10
5	Assess flux control coefficients by direct and indirect methods.	Evaluate	2	4, 5,9,10
6	Rationalize the use of top-down and bottom-up approaches of metabolic network discovery.	Create	2	1, 5,9,10

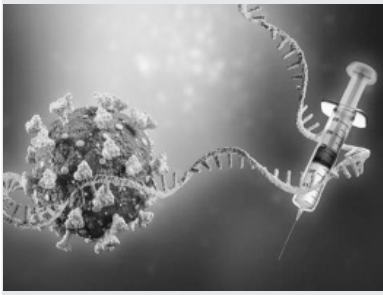
TEXT BOOKS:

1. Stephanopoulos G, Aristidou AA, Nielsen J, “Metabolic Engineering: Principles and Methodologies”, 1st edition, Academic Press, 1998.
2. Cortassa SD, Aon MA, Aon JC, Iglesias AA, Lloyd D, “Introduction to Metabolic and Cellular Engineering”, 1st edition, World Scientific, 2011.

REFERENCE BOOKS:

1. Cheng Q, editor, “Microbial Metabolic Engineering: Methods and Protocols”, 1st edition, Humana Press, 2012.
2. Challacombe JF, “Metabolic Pathway Engineering: Analysis and Applications in the Life Sciences” 1st edition, CRC Press, 2021.
3. S. Y. Lee, E.T. Papoutsakis, “Metabolic Engineering”, 1st edition, CRC Press, New York, 1999.

22BT815 VACCINOLOGY



Source: https://www.bioprocessonline.com/doc/what-s-all-the-hype-about-mrna-vaccinology-0001

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Cell and Molecular Biology, Microbiology and Fermentation Technology.

COURSE DESCRIPTION AND OBJECTIVES:

This course deals with fundamentals of vaccination and types of vaccine platforms. The topics relating to the vaccine design and vaccine manufacturing are also indicated. Hence, the students who undergo this course will acquire knowledge on the herd immunity, adult vaccination schedule and sustenance of community health.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

VACCINATION

History of vaccination, Importance of vaccination, Disease burden due to vaccine preventable diseases, Immunization - live, killed, attenuated, subunit vaccines, Vaccination routes, Properties of adjuvants, Pneumococcal conjugate vaccines, Toxoids and anti-toxins.

UNIT-2 **10L+0T+10P=20 Hours**

APPLICATIONS

Vaccines for tropical diseases-malaria, diarrhea, influenza, tuberculosis. Pediatric, Adolescent and Elderly vaccines, Anti-ovarian cancer vaccines, Anti- pregnancy vaccines, Hybrid monoclonal antibodies, Single chain (SCFV) antibodies.

PRACTICES:

- Antigen selection from the viral pathogens of the choice of student. Browsing NCBI for the sequence of the chosen antigen.
- Prediction of sequential and conformational epitopes for the chosen antigen.
- Epitope prediction using RANKPEP.
- Allergy prediction using AlerTop.
- Construct a disease burden grid using the online data for any two communicable diseases.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

VACCINE MANUFACTURING

Procedure for Vaccine manufacture, Vaccine, safety, Clinical evaluation, Role of regulatory agencies in vaccine testing and licensing, Domestic and international vaccine policy, Ethical considerations and regulatory issues.

UNIT-2 **10L+0T+10P=20 Hours**

PROTEIN BASED VACCINES

Epitope mapping and phage display, Recombinant DNA and protein-based vaccines, Reverse vaccinology, Peptide vaccines, Vaccine design using online tools, Viral-like particles (VLPs), Dendritic cell-based vaccines.

SKILLS:

- ✓ *Epitope prediction*
- ✓ *Design of protein-based vaccines*
- ✓ *Prediction of toxicity due to vaccine*

PRACTICES:

- Design vaccine with the chosen antigen using online tools.
- Population coverage using IEDB tool.
- Building a model of SCFV antibody.
- Building a model of Reverse Vaccinology.
- Building a model for the promotion of vaccination in the population.
- Prepare a protein-based vaccine and immunize a mouse.
- Evaluate antibody titer.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Evaluate the role of vaccines in the prevention of communicable and therapeutic diseases.	Evaluate	1	2,3,6,7,9,10
2	Apply knowledge of immunology to manufacture vaccines.	Apply	1	1,3,4,6,7,8,9,10
3	Evaluate the methods of vaccine development in different biopharmaceutical companies.	Evaluate	2	3,4,5,6,7,9,10
4	Design experimental frame work for preparation of different classes of vaccines.	Create	2	3,4,5,6,9,10

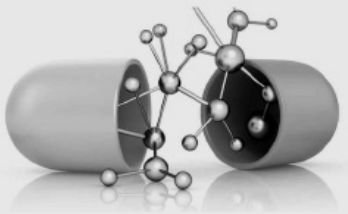
TEXT BOOKS:

1. Thomas J Kindt, Barbara A Osborne and Richard AGoldsby, “Kuby Immunology”, 9th edition, WH Freeman, 2016.
2. Kenneth Murphy, “Janeway’sImmunobiology”, 9th edition, Garland Science, 2016.

REFERENCEBOOKS:

1. Myers RL, “Immunology: A laboratory manual”, 1st edition, Brown William C,2007.
2. Prugnaud JL, Trouvin JH, “Biosimilars: A new generation of Biologics”,1st edition, Springer, 2012.
3. Glick BR, Patten CL, “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, 6th edition, John Wiley & Sons, 2022.

22BT819 COMPUTER AIDED DRUG DESIGN



Source: https://q-more.chemeurope.com/q-more-articles/223/perspectives-of-computer-aided-drug-design.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Bioinformatics, Organic chemistry, Biochemistry and Enzymology.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers knowledge on current approaches and principles of drug design processes. It helps to learn the different computational drug designing techniques to develop the novel, safe and effective drugs which reduce the cost and time of drug discovery process.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO DRUG DISCOVERY

Drugs; principles of drug development, Chemoinformatics and Pharmacoinformatics, Structure-based drug designing approaches-target identification, hit validation, active site/binding site prediction and analysis, molecular docking and types.

UNIT-2 **10L+0T+10P=20 Hours**

TYPES OF DRUG DESIGN

Ligand-based drug designing approaches-lead designing, combinatorial chemistry, high throughput screening (HTS), QSAR, 2D-QSAR, pharmacophore mapping, database generation and chemical libraries, ADME properties.

PRACTICES:

- Perform homology modeling using I-TASSER.
- Docking studies using Auto Dock Vina.
- Active site prediction of protein using CastP.
- Protein secondary structure prediction using SOPMA.
- QSAR studies of drug.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

DRUG ACTION

Theories of enzyme inhibition and inactivation, Enzyme activation of drugs and prodrugs, Concept of drug like molecules, Pharmacophore hypotheses, Lipinski's rule of five.

UNIT-2 **10L+0T+10P=20 Hours**

DRUG DESIGN POLICIES

Quality assurance, ISO, WHO, NIH, NDA, Food and drug administration (FDA), IPR, Good manufacturing practices (GMP), Good laboratory practices (GLP).

PRACTICES:

- Retrieving pathways from KEGG & BRENDA.
- Finding out drug likeliness using Lipinski's rule of five.

SKILLS:

- ✓ *Performing homology modelling of proteins.*
- ✓ *Docking of ligand with corresponding target.*
- ✓ *Protein secondary structure prediction using Ramachandran Plot.*

- Smiles notation of drug compounds.
- Design of ligands by Chemdraw.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the current approaches of drug discovery processes.	Analyse	1	1,2,4,9,10
2	Apply the steps involved in ligand-receptor and ligand-enzyme binding for novel drug discovery.	Apply	1	1,2,3,9,10
3	Create 3D structures of macromolecules by applying homology modelling techniques.	Create	2	3,4,5,9,10
4	Evaluate the pharmacokinetics and pharmacodynamics of novel drugs using pharmaco informatics principles.	Evaluate	2	3,4,5,9,10

TEXT BOOKS:

1. K. I. Ramachandran, GopakumarDeepa and Krishnan Namboori, “Computational Chemistry and Molecular Modeling”, 1st edition, Springer, 2008.
2. Hans-Dieter Holtje, Wolfgang Sippl, Didier Rognan and GerdFolkers, “Molecular Modeling: Basic Principles and Applications”, 3rd edition, Wiley, 2008.

REFERENCE BOOKS:

1. Tagelsir Mohamed Gasmelseid, “Pharmacoinformatics and Drug Discovery Technologies: Theories and Applications”, 1st edition, Idea Group, 2012.
2. Jan H. Jensen, “Molecular Modeling Basics”, 1st edition, CRC Press, 2010.
3. M. Rami Reddy, Mark D. Erion, “Free Energy Calculations in Rational Drug Design”, 1st edition, Springer, 2001.

22BT822 HEALTH INFORMATICS

Source: https://www1.villanova.edu/content/university/liberal-arts-sciences/programs/computing-sciences/graduate-programs/certificate-health-informatics/_jcr_content/pagecontent/image.img.jpg/1619470102785.jpg

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Basics of biology.

COURSE DESCRIPTION AND OBJECTIVES:

Health (medical) informatics is the intersection of information science, computer science, and health care. This field deals with the resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

MODULE -1

UNIT-1 **12L+0T+0P=12 Hours**

INTRODUCTION

Introduction and overview of informatics in hospital management system, brief history of medical informatics, Nursing informatics, Public health informatics, health information ethics.

HEALTH CAREDATA, INFORMATION AND KNOWLEDGE: Electronic health records and automatic updating of health records, Electronic medical records, the language of biomedical informatics, Health in formation exchange.

UNIT-2 **10L+10T+0P=20 Hours**

APPLICATIONS

Vaccines for tropical diseases-malaria, diarrhea, influenza, tuberculosis, swineflu vaccines, Pediatric, Adolescent and Elderly vaccines, Anti-ovarian cancer vaccines, Anti Pregnancy vaccines, Monoclonal antibodies, Single chain (SCFV) antibodies.

PRACTICES:

- General concepts in Health Informatics.
- Collect the patient datathrough internet.
- Analysis the data.
- General concepts in Health Informatics.
- Collect the patient data through internet.
- Analysis the data.

MODULE -2

UNIT-1 **6L+6T+0P=12 Hours**

MEDICAL STANDARDS

Evolution of Medical Standards, IEEE 11073, HL7,DICOM, IRMA, LOINC,HIPPA, Electronics Patient Records, Healthcare Standard Organizations, JCAHO (Joint Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation), Evidence Based Medicine, Bioethics.

UNIT-2 **10L+10T+0P=20 Hours**

RECENT TRENDS IN HEALTH INFORMATICS

Medical Expert Systems, Virtual Environment, Surgical simulation, Radiation therapy and planning, Telemedicine, virtual Hospitals, Smart Medical Homes, Personalizede-health services, Biometrics, GRID and Cloud Computing in Medicine.

INFORMATION TECHNOLOGY IN HEALTH RESEARCH: The use of Information technology

SKILLS:

- ✓ *Calculus in medical bioinformatics.*
- ✓ *Statistical Hypothesis testing.*

inaccessing the literature, Health related electronic bibliographic databases, software for handling the health research data.

PRACTICES:

- Collect the new forms of clinical information.
- Electronic Health Record analysis.
- Find thedoctor using of information sources.
- Howto apply Probability in health informatics data.
- Use truth tables in medical informatics data.
- Apply predicate calculusin medical bioinformatics.
- Hospital Management and Information systems.
- Statistical hypothesis testing in Medical informatics.
- Clinical data management (an overview).

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Adopt computational tools for maintenance of electronic health records.	Apply	1	2,6,7,9,10
2	Examine the expertise with information systems that collect, manage, access, assess, and interpret health care / public health data using communication and computer technologies.	Evaluate	1	2,4,9,10
3	Demonstrate how informatics approaches and resources may be used strategically to improve health care delivery and public health.	Apply	2	1,2,4,9,10
4	Articulate the importance of collaboration among medical, public health, communication and informatics specialistsin the process of design, implementation, and evaluation of healthcare/ public health programs.	Apply	2	3,6,9,10

TEXT BOOKS:

1. R.D.Lele, “Computers inmedicine progress in medical informatics”, 1st edition, Tata Mc Graw Hill Publishing Ltd, 2015.
2. Mohan Bansal, “Medical informatics”, 1st edition, Tata McGraw Hill Publishing Ltd, 2013.

REFERENCE BOOKS:

1. James W. Lee, “Advance Biofuels and Bioproducts”, 1st edition, Springer, 2013.
2. G. Chen, Randall J. Weselake and Stacy D. Singer, “Plant Bioproducts”, 1st edition, Springer, 2018.
3. Graham P Bunn, “Good manufacturing Practices for Pharmaceuticals”, 7th edition, Taylor & Francis, 2021.
4. Sandy Weinberg, “Good laboratory Practice regulations”, 4th edition, Taylor & Francis, 2007.

22BT828 REGULATORY AFFAIRS AND CLINICAL TRAILS

Source: https://fusion-pharma-limited.com/combined-review-service/

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Good Manufacturing Practices.

COURSE DESCRIPTION AND OBJECTIVES:

The course is designed to make the student acquaint with rules, regulations and guidelines for clinical trials and how they are applicable in different countries. Also, to understand the importance of medical ethics, IVF, audit types, audit processing in clinical trials.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

MEDICAL ETHICS, AUDITING & REGULATIONS OF CLINICAL RESEARCH

ICH-GCP guidelines, licensing authorities -roles and responsibilities of FDA, EU clinical trial directive, data protection act, declaration of Helsinki 2000 amendment and codes of practice, regulations relating to electronic signatures. Ethics in all aspects of health care, historical cases, negligence, informed consent, mental competence Up – to – date cases: cloning, human embryos and IVF, The purpose of audits, types of audits, preparing for audits - in company, on site, The audit process.

UNIT-2 **10L+10T+0P=20 Hours**

ETHICS

Shared responsibilities for decisions and the understanding of risk - INDIAN / USA / EU ethics approval system, Typical audit finding, The INDIAN / USA/ EU directives on GCP in clinical trials - purpose, how will the introduction affect clinical research, extracts from the guidance documents, possible sanctions for non- compliance - legal and regulatory, commercial and professional.

PRACTICES:

- Prepare a report on clinical trials in vaccine development.
- Compile ethical issues related to human cloning and embryos.
- Review on palliative care-promotion and implementation.
- Summarize ethics of randomization and blinding, preliminary data /medical cases and placebo.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

REGULATORY AFFAIRS

History of regulatory affairs, main concepts QSE, sources of information, regulatory affairs for studies in human subjects and required data, Current and future european, US perspectives, requirements and procedures, Drug preparation and packaging, EMEA, european directives and MRECs, ethics committees – history and structure.

UNIT-2 **10L+10T+0P=20 Hours**

PRODUCT APPROVAL

Regulatory submissions for new products, requirements for gaining approval, US perspective, regulating control over marketing and sales of medical products, regulations, codes of practice, promotional materials, Inputs of Indian guidelines & Indian perspectives.

SKILLS:

- ✓ *Design protocols for audit processing.*
- ✓ *Conduct survey on medical ethics in local hospitals.*
- ✓ *Collect data on IVF implementation strategy in nearest IVF center.*

PRACTICES:

- Review on the functionality of CDSCO.
- Overview of Indian regulatory structure for clinical trails.
- Report on regulations on vaccine approval in India.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze rules, regulations and guidelines of clinical trials.	Analyze	1	3,4,9,10
2	Compile regulations on clinical trials of different countries.	Create	1	4,6,9,10
3	Evaluate medical ethics, IVF, audit types and audit processing.	Evaluate	2	3,4,8,9,10
4	Analyze the regulatory affairs related to human subjects.	Analyze	2	2,3,4,5,9,10

TEXT BOOKS:

1. Douglas J. Pisano, David S. Mantus, “FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics”, 2ndedition,Informa Healthcare,2008.
2. Wendy Bohaychuk, Graham Ball, “Conducting GCP-Compliant Clinical Research” John Wiley, 1st edition, 1999.

REFERENCE BOOKS:

1. John J. Tobin, Gary Walsh, “Medical Product Regulatory Affairs: Pharmaceuticals, Diagnostics, Medical Devices”, 1st edition, Wiley-VCH, 2008.
2. Stephen Amato; Bob Ezzell, “Regulatory Affairs for Biomaterials and Medical Devices”, 1st edition, Woodhead Publishing, 2014.
3. Agarwal SP, “Good clinical practices for clinical research in India”, 1st edition, 2014.

22BI808 BIOLOGICAL BIG DATA MANAGEMENT AND ANALYTICS

source: https://www.cancer.gov/research/infrastructure/bioinformatics

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Biological Databases, Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course familiarizes students with management of biological data which involves acquisition, modelling, storage, integration, analysis and interpretation of diverse biological data.

MODULE-1

UNIT-1 **6L+0T+6P= 12 Hours**

INTRODUCTION

Introduction to Big Data and Analytics, Big Data Overview Characteristics of Big Data Business Intelligence vs Data Analytics. Need of Data Analytics, Data Analytics Life Cycle Data Analytics in Industries Exploring Big data Challenges in handling Big Data.

UNIT-2 **10L+0T+10P= 20 Hours**

IMPORTANCE OF OMIC TECHNOLOGIES, NGS DATA COLLECTION AND BIOINFORMATICS PRINCIPLES

Data standards for omic data: the basis of data sharing and reuse. Omic data management and annotation. Data and knowledge management in cross omics research projects. Statistical analysis principles for omic data.

PRACTICES:

- Extract the features based on various color models and apply on image and video retrieval
- Counting things using MapReduce
- Unix/Linux Command Line mode, file and directory handling, Vi Editor.
- Unix shell scripts – conditional operators, looping, string handling.
- Working with Hadoop and Basic operations in Excel sheet and calculation of big datasets.
- Basic R commands, Normalization and Gene expression studies on GEO datasets.
- Overview of Python – Working with nucleic acid and protein sequences.
- Analyzing the 3D structure using Python programming.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

NUCLEICACIDS AND DNA REPLICATION

Statistical methods and models for bridging Omics data levels. Analysis of time course omics datasets. The use and abuse of Omics. Computational analysis of High Throughput Sequencing Data Analysis of SNP in case control studies. Bioinformatics for RNomics. The ENCODE project consortium. Data Mining for specific applications.

SKILLS:

- ✓ *Working with Hadoop, pyspark for biological data management.*
- ✓ *ETL for health data analysis extraction transformation and loading.*
- ✓ *Big data analytics in genomic medicine*

UNIT-2 **10L+0T+10P=20 Hours**

TRANSCRIPTION AND TRANSLATION

Transcriptome Resequencing and Chip Sequencing Analytics Introduction to RNA-Seq Sequencing Alignment, Indexing the reference genome, Alignment Tools and its Parameters, Aligning Single End / Paired End reads to the indexed genome

Denovo Whole Genome and Transcriptome Assembly analytics Introduction to Whole Genome Denovo Sequencing, Understanding Various Assembly Algorithms, Assembly Tools and its Parameters, Scaffolding and Constructing Draft Genome

PRACTICES:

- Quality checking and trimming using free and commercial software.
- Bacterial genome assembly using Velvet and Soap Denovo assembly.
- References genome assembly using BWA and CLC Genomic Workbench.
- Genome Annotation using Gene Ontology (GO).
- Identification of SNPs using Cancer genome datasets (GATK Pipeline).
- Genome browser- UCSC and Ensemble genome browser and comparative genomics.
- Whole genome (WGS), Transcriptome (RNA, Exome) and Chip-Seq analysis using Cloud based server.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Decipher the differences in the types of databases and their data formats.	Apply	1	1,4,5,9,10
2	Apply the knowledge of various Omics experiments, data generation techniques, data management concepts, data mining strategies and their effective utilization.	Apply	1	1,4,5,9,10
3	Comprehend the aspects of Clinical Data, data integration, data Management, data mining for defined applications.	Analyze	2	2,4,5,7,9,10
4	Study the importance of various Omics experiments, data generation techniques, data management strategies and their effective utilization	Analyze	2	2,4,5,7,9,10

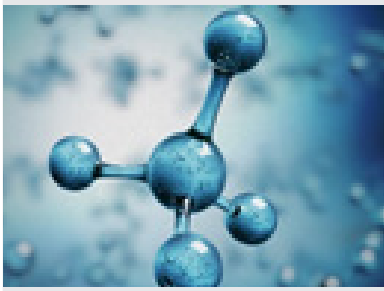
TEXT BOOKS:

1. DovStekel, “Microarray Bioinformatics”, 1st edition, Cambridge University Press, 2003.
2. Draghic S., Chapman, “Data Analysis tools for DNA Microarray”,1st edition, Hall/ CRC Press, 2002.

REFERENCE BOOKS:

1. Wang , “Computational Biology and Genome Informatics”, 1st edition, World Scientific, 2003.
2. Wang, “Pattern Discovery in Biomolecular Data: Tools, Techniques and Applications”, 1st edition, Oxford University Press, 1999.
3. Uwe R. Muller, Dan V. Nicolau, “Microarray Technology and its Applications”,1st edition, springer, 2005.

22BI809 CHEMINFORMATICS AND QSAR



source: https://www.gsitechnology.com/Introducing-a-Cheminformatics-Similarity-Structure-Search-Solution

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Drug design.

COURSE DESCRIPTION AND OBJECTIVES:

This course is intended to deliver strong foundation in biochemistry and enzymology concepts. It includes macromolecules and their metabolism. It also covers the fundamentals of enzymology, classification, kinetics and immobilization techniques.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INTRODUCTION TO CHEMINFORMATICS

The domain of Chemistry - The scope of Cheminformatics - Learning in Cheminformatics, Structure Elucidation - Quantitative Structure - Activity Relationships - Chemical Reaction and synthesis design.

UNIT-2 **10L+0T+10P=20 Hours**

DATABASES AND DATA SOURCES IN CHEMISTRY

Data, Information and Knowledge Data Preprocessing - Variable selection - Preparation of datasets for validation of the model quality - Databases in the Information System-Catalogs of Chemical Compound - ChemInform RX-Reaction Retrieval.

.**PRACTICES:**

- List the different databases for retrieval of ligands
- List different cheminformatics tools.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

CALCUALTION OF DESCRIPTORS

Empirical approaches to the Calculation of Properties - Drug Receptor Binding energies - Quantitative Descriptors of Chirality - BCUT Descriptors - HYBOT Descriptors - 4D QSAR

UNIT-2 **10L+0T+10P=20 Hours**

APPLICATIONS

Prediction of Properties of Compounds - Linear Free Energy Relationship (LFER) - Quantitative Structure-Property Relationship (QSAPR) model - Target Identification and Validation - Lead Finding and Optimization.

PRACTICES:

- How do you predict the properties of compounds?
- What is the QSAPR model.
- Calculation of the binding energy between receptor and ligand Estimation of Michaelis -Menten parameters.

SKILLS:

- ✓ *Detection of macromolecules by biochemical and calorimetric assays.*
- ✓ *Quantification of biomolecules using spectrophotometer.*

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	To retrieve specific information from the enormous and rapidly expanding chemical literature	Apply	1	1,2,4,9,10
2	To provide a broad overview of the computer technology to chemistry in all of its manifestations	Analyze	1	1,2,5,9,10
3	To expose current and relevant applications in QSAR and Drug Design	Apply	2	1,3,9,10

TEXT BOOKS:

1. Johann Gasteiger and Thomas Engel, ‘’Cheminformatics: A textbook’’, 1st edition, WILEY VCH Publisher, Germany, 2003.

REFERENCE BOOKS:

1. Andrew R. Leach and Valerie J. Gillet, ‘’Introduction to Cheminformatics’’, 1st edition, Kluwer Academic Publisher, Netherlands, 2003.
2. Andrew R. Leach, “An Introduction to chemoinformatics”, 1st edition, Springer, 2020.
3. Bajorath, “Chemoinformatics for drug discovery”, 1st edition, John Wiley, 2014.

22BI810 GOOD LABORATORY PRACTICES

source: https://journalsofindia.com/good-laboratory-practice-glp-working-group-of-oecd/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Genetic Engineering, Industrial Biotechnology.

COURSE DESCRIPTION AND OBJECTIVES:

The course provides insights about regulations and standards associated with GLP and GMP followed in industries. Further, create awareness on safety standards and the fundamental requirements of GLP and consequences of noncompliance for regulated laboratories.

MODULE-1

UNIT-1 **8L+0T+8P=16 Hours**

GOOD LABORATORY PRACTICE

Good laboratory Practices-Fundamentals; WHO guidelines on GLP and GMP; History of Good Laboratory Practices; Quality assurances in GLP.

UNIT-2 **8L+0T+8P=16 Hours**

QUALITY STANDARD AND ASSURANCES

Quality standards- advantages and disadvantages, concept of quality control; Quality assurance- their functions and advantages; Quality assurance and quality management in industry; Customer requirement of quality; Government and trade standards of quality federal food and drug law, FDA action, BSTI: action, activities and other food laws (Legalization).

PRACTICES:

- Indian policies related to GMP and GLP.
- Laws related to FDA.
- Quality standards for manufactured products.
- Report on WHO guidelines pertaining to GLP and GMP.

MODULE-2

UNIT-1 **8L+0T+8P=16 Hours**

QUALITY CONTROL

Introduction to quality control and total quality control in the food industry; Various quality attributes of food such as size, shape, texture, color, viscosity and flavor; Instrumental, chemical and microbial quality control; Sensory evaluation of food and statistical analysis; Food regulation and compliance; Food inspection and food law.

UNIT-2 **8L+0T+8P=16 Hours**

BACKGROUND, BIOSAFETY IN LABORATORY/ INSTITUTION

Laboratory associated infections and other hazards; Assessment of biological hazards and levels of biosafety; Prudent biosafety practices in the laboratory/institution; Introduction to biological safety cabinets; Primary containment of biohazards. Biomedical waste management, biosafety levels; Recommended biosafety levels for infectious agents and infected animals' bio safety guidelines; Government of India guidelines, definition of genetically modified organisms (GMOs).

SKILLS:

- ✓ *Following good laboratory practices*
- ✓ *Assessing the quality of products.*
- ✓ *Handling hazardous chemicals*

PRACTICES:

- Quality control management in industry considering two industry examples.
- A report on Food inspection laws.
- Examination and preparation of a report on the functioning of biosafety cabinets in the biotechnology lab including the components.
- A report on Biomedical waste management in India.
- Disposal of biological and radio isotope wastes.
- Biosafety levels and related infectious agents handling.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze GLP environment.	Analyze	1	2,6,7,8
2	Apply the principles of GLP.	Apply	1	1,4,7,8,5
3	Evaluate the risks and environmental release of GMO's.	Evaluate	2	6,7,8
4	Create awareness on biosafety guidelines.	Create	2	3,6,7,8

TEXT BOOKS:

1. Syed Imtiaz Haider, "Pharmaceutical Master Validation Plan the Ultimate Guide to FDA, GMP, and GLP Compliance", 1st edition, St. Lucie, 2002.
2. Hubbard MR, "Statistical quality control for the food industry", Springer Science & Business Media, 3rd edition, 2012.

REFERENCE BOOKS:

1. Richmond JY, McKinney RW, "Biosafety in microbiological and biomedical laboratories", US Government Printing Office, 2009.
2. Nally JD, "Good manufacturing practices for pharmaceuticals", 1st edition, CRC Press, 2016.
3. Sharp J, "Good pharmaceutical manufacturing practice: rationale and compliance", 1st edition, CRC Press, 2004.

22BI811 SYNTHETIC BIOLOGY

source: https://www.meer.com/en/20807-synthetic-biology

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Enzyme technology and systems biology.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides insights into cellular and population-level systems biology with an emphasis on synthetic biology, modeling of genetic networks, cell-cell interactions, and evolutionary dynamics.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

GENE EXPRESSION BASICS

Central dogma: transcription, reverse transcription, translation, post-translational modification, Transcriptional regulation: Biology & engineering systems, Post-transcriptional regulation: Biology & engineering systems, DNA assembly and synthesis, Directed and continuous evolution.

UNIT-2 **10L+0T+10P=20 Hours**

BACTERIAL CIRCUITS

Noise in gene expression: Origin, propagation, consequences, and control, Robustness and evaluability of genetic networks, Bacterial circuits: Toggle switch and repressilator, Feedback, feed-forward, signal propagators, and band filter, Bacterial communication circuits: Population control and patterning systems, Synchronized oscillators

PRACTICES:

- SynBiopython: an open-source software library for Synthetic Biology
- Synthetic Gene Designer: A web platform that allows codon optimization to various extent
- Optimizing melting temperature during gene synthesis using DNA Works
- Calculate extinction coefficients, Tm's, and base composition for your DNA or RNA, amino acid composition and extinction coefficient for your protein using Biopolymer calculator
- Construct computational models using biological parts, cells, and modules using CAD Tools.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

SYNTHETIC CIRCUITS

Genetic Circuits in Eukaryotes: How to build genetic circuits in yeast, Logic gates in yeast, non-coding RNAs and its characteristics, Application of ncRNAs on circuit designs, Riboswitches; microRNAs; siRNAs.

UNIT-2 **10L+0T+10P=20 Hours**

BIOMATERIALS

Gene circuit design and engineering: Biobricks/BioFAB and designing software, Synthetic circuits beyond bacteria: Phage, virus, and eukaryotic, In vitro/cell-free systems Applications: Biomedicine and biomaterials, Applications: Biofuels and bioremediation.

SKILLS:

- ✓ *Design Oscillatory genetic networks*
- ✓ *Study of the interactions between the components of biological systems*
- ✓ *Study of Stochastic modeling, Network modeling, and analysis*
- ✓ *Practicing Mass Spectrometry-Based Proteomics*

PRACTICES:

- A back translation method based on codon usage strategy using BBOCUS (BackTranslation Based On Codon Usage Strategy)
- j5: DNA assembly design automation for (combinatorial) flanking homology (e.g., SLIC/Gibson/CPEC/SLiCE/yeast) and type IIs-mediated (e.g., Golden Gate/FX cloning) assembly methods
- Visualize plasmid variables (circular view) and strand variables (linear view) as composites of iGEM parts and devices using Cytostudio
- Manipulation of genetic information; from genes to plasmids to whole genomes with Genome Compiler genetic engineering design tool..

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyse the properties of the cell or the organism with help of genetic networks	Analyse	1	2,3,4,9,10
2	Apply the advanced tools for integration of basic synthetic units into multi component devices	Apply	1	1,2,3,4,9,10
3	Analyse naturally-occurring biological systems to create artificial gene networks	Create	2	1,2,3,9,10
4	Evaluate the methods of genome editing for gene repair	Evaluate	2	2,3,5,9,10

TEXT BOOKS:

1. Uri Alon, “An Introduction to Systems Biology: Design Principles of Biological Circuits”, 1st edition, Chapman & Hall/CRC, 2006.
2. Eric Davidson, “The Regulatory Genome: Gene Regulatory Networks in Development and Evolution”, 1st edition, Academic Press, 2006.

REFERENCE BOOKS:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter, “Molecular Biology of the Cell”, 4th edition, Garland Science, 2002
2. Robert Brooks Phillips, Jane Kondev and Julie Theriot, “Physical Biology of the Cell”, 1st edition, Garland Science, 2008.
3. Hamid Bolouri, “Computational Modeling of Gene Regulatory Networks - A Primer”, 1st edition, Imperial College Press, 2008

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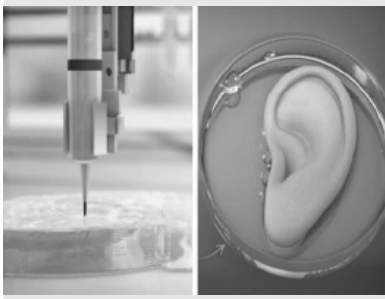
22BT801 3D BIOPRINTING



Source: https://interestingengineering.com/the-science-fiction-world-of-3d-printed-organs

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Cell and Molecular biology, Applied Physics.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers insights about stereo lithography and fused deposition modelling. It also emphasizes the principles; design software's and file formats for 3D objects. It provides knowledge on different application of additive manufacturing of biomaterials.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

TISSUE ENGINEERING

Need for the in vitro development of organs and parts of organs for in situ placements, Tissue engineering, Scaffolds in Tissue engineering, classification of rapid prototyping systems, Types of 3D Bioprinting - Extrusion based Bioprinting, Droplet based Bioprinting, laser based Bioprinting, Applications of 3D Bioprinting used in biosensor constructions.

UNIT-2 **10L+10T+0P=20 Hours**

BIOCOMPATIBLE MATERIALS

Chemical and physical properties of biocompatible materials, synthetic sources and natural sources-marine source, plant sources, hydrogels, ceramics and glasses, cell sources, cell culture media, seeding of cells, cell viability and challenges, processing of cells for bioprinting, bioink-collagen, alginate, cellulose, fibronectin, RGD and carrageenan.

PRACTICES:

- A review on the preparation of cell type, bioink and scaffolds in 3D bioprinting.
- A report on the scaffolds used in tissue engineering.
- Compilation of different Bioink material used in 3D bioprinting.
- A report on the functioning of Extrusion based bioprinting.
- A review on the merits and demerits of Ink jet based bioprinting.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

TISSUE SCAFFOLDS

Scaffolds for tissue engineering, scaffold design and fabrication, Additive manufacturing techniques of Scaffolds, Applications of additive manufacturing scaffolds, challenges and clinical considerations with scaffold-based tissue engineering, Scaffold-based and scaffold-free 3D Bioprinting, cross - linkers - Ionic, enzymatic, physical, light and temperature based - advantages and limitations.

UNIT-2 **10L+10T+0P=20 Hours**

DESIGN FOR ADDITIVE MANUFACTURING

Design for assembly, manufacturing and additive manufacturing, STL for slicing and layering, Design for support - Overhangs, built orientation, Design for finishing, Design for aesthetics, DICOM & STF file format G-Code, Applications of CAD, Fusion 360 software and BIOVIA material studio.

SKILLS:

- ✓ *Bio-ink preparations using natural biomaterials and cells.*
- ✓ *Assembling of extrusion-based 3D Bioprinting.*
- ✓ *Selection of biocompatible agents for scaffoldings.*
- ✓ *Maintenance of sterile environment during 3D bioprinting.*

PRACTICES:

- Design a 3D model for the skin tissue bioengineering.
- Report on the software and their formats: STL file, G-code file and DICOM file formats.
- Review on Fusion 360 software.
- Review on Biovia material studio applied in 3D bioprinting.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the processes of 3D bio-printing methods.	Analyze	1	1,2,9,10
2	Formulate bioink for manufacturing of tissue engineering materials.	Apply	1	2,3,5,9,10
3	Evaluate and analyze biocompatible agents to be used in scaffolds.	Evaluate	2	2,3,4,9,10
4	Apply software tools for design of 3D objects.	Apply	2	1,4,5,9,10

TEXTBOOKS:

1. Chee Kai Chuaand Wai Yee Yeong, “Bioprinting: Principles and Applications, 1st edition, World Scientific, 2015.
2. Ibrahim Tarik Ozbolat, “3D Bioprinting: Fundamentals, Principles and Applications”, 1st edition, Elsevier, 2017.

REFERENCEBOOKS:

1. Barnatt C, “3D printing”, 3rd edition, Create Space Independent Publishing Platform, 2016.
2. Kumar LJ, Pandey PM, Wimpenny DI, “3D printing and additive manufacturing technologies”, 1st edition, Springer, 2019.
3. Khademhosseini A, Camci-Unal G, “3D bioprinting in regenerative engineering: principles and applications”, 1st edition, CRC Press, 2018.

22BT804 BIOETHICS AND INTELLECTUAL PROPERTY RIGHTS

Source: https://www.mdpi.com/2075-471X/10/2/24

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Cell and Molecular Biology, Genetic Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course describes ethical perspective and moral obligations related to biotechnology. It also imparts knowledge on intellectual property and its legalities. The objective of this course is to create awareness on legal rights, responsivities, regulatory affairs and ethical stand point of intellectual assets in the field of biological research.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

BIOETHICS

Engineering ethics, Social and ethical issues in biotechnology, Biosafety for human health and environment, Regulation, national and international guidelines of biosafety, rDNA guidelines, regulatory requirements for drugs and biologicals, GLP and GMP.

UNIT-2 **10L+10T+0P=20 Hours**

ENVIRONMENTAL ETHICS

Computer ethics, Weapons development and bioterrorism, Engineers as managers, Consulting engineers, Moral leadership, Sample code of ethics, Conflicts of interest, Occupational crime and hazards, Special procedures for rDNA-based products, transgenic plants and animals, Roles of institutional biosafety committees - RCGM, GEAC etc., Assessment of safety and risk, Risk benefit analysis.

PRACTICES:

- Report on three-mile island.
- Commentary on Chernobyl nuclear accident.
- Survey on IKEA and environmental ethics.
- Review on Biosafety of rDNA based products.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

INTELLECTUAL PROPERTY RIGHTS

TRIP and GATT, Concept of intellectual property, Kinds of intellectual property - patents, copyrights, designs, trademarks, geographical indication, WTO guidelines.

UNIT-2 **10L+10T+0P=20 Hours**

PATENTS

Requirement of patentable novelty, inventive step, classifying products as patentable and non-patentable procedure for applying patent, biological patentability, Infringement of IPR, its protection and remedies, Farmers rights and plant breeder's rights.

PRACTICES:

SKILLS:

- ✓ *Appreciating scientific article/ patent.*
- ✓ *Knowing the procedure for a patent application.*
- ✓ *Learn engineering discoveries towards the betterment of the society.*
- ✓ *Familiar with farmers' and plant breeders' rights*

- Survey on patent in fringement cases in India.
- Review on significant copy right in fringement cases.
- Commentary on Coca-Cola vs. Pepsi Cola.
- Report on McDonald's loses trade mark battle to Malaysia's 'McCurry'.
- Awareness and preparation of the report on traditional knowledge and paten tissues - concerning turmeric, neem and basmati rice.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Create awareness on good laboratory and manufacturing procedures.	Create	1	1, 6,7,9,10
2	Apply bioethics in manufacturing and marketing of bioproducts.	Apply	1	1,9,10,12
3	Analyze the key issues of biosafety, bioethics and IPR.	Analyze	2	2, 8,9,10
4	Apply appropriate intellectual property rights for protecting the individual rights in the society.	Apply	2	1,6,8,9,10

TEXT BOOKS:

1. M Martinand and R Schinzinger,"Ethics in Engineering", 1st edition, McGraw Hill, 2000.
2. M Govindarajan, S Natarajan and V S S Kumar, "Engineering Ethics",1st edition, Prentice Hall, 2004.

REFERENCEBOOKS:

1. Sasson,"Biotechnologies and Development", 1st edition, UNESCO,1988.
2. Sasson,"Biotechnologies in developing countries present and future", 1st edition, UNESCO,1993.
3. E G Seebauer and R L Barry, "Fundamentals of Ethics for Scientists and Engineers", 1st edition, Oxford, 2001.

22BT810 PHAGE DISPLAY

Source: https://www.news-medical.net/life-sciences/Phage-Display-Explained.aspx

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Cell and Molecular Biology, Genetic Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

This course provides knowledge on principles of phage display, properties of phage display vectors, role of phage display in antibody engineering, medicine and therapy. It enables the students to learn about the Fab fragment, sCFV and phage displayed peptide libraries.

MODULE-1

UNIT-1 **6L+6T+0P=12Hours**

BACTERIOPHAGES

A historical perspective, Biology of bacteriophages, Structural characterization and lifecycles of M13, T4 and T7 bacteriophages, Phage typing and their expression.

UNIT-2 **10L+10T+0P=20 Hours**

PHAGE DISPLAY

Phage display vectors, antibody libraries, phagemid-displayed peptide libraries, functional domains and scaffolds, Phage display for epitope mapping of antigens, applications of phage display.

PRACTICES:

- Sequential steps in the isolation of bacteriophages from sewage water.
- Report on culturing of bacteriophages-T4, T7and M13.
- Develop models on replication of bacteriophages.
- Report on Phage lysate and Bacteriophage titer assay.
- Model preparation on the Phage display of sCFV.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

SCFV

Identification and analysis of selected antibodies, production and purification of fab fragment and sCFV, Amplification of antibody genes - PCR amplification and assembly of light and heavy chain coding regions, Cell surface selection markers and analysis of monoclonal antibodies from phage libraries.

UNIT-2 **10L+10T+0P=20 Hours**

ANALYSIS OF PHAGE BORNE PEPTIDES

Construction and use of phage displayed peptide libraries, construction and selection from cDNA phage display expression libraries, applications of phages in medicine and therapy; Phage therapy, phage lysins and phages as vaccine delivery vehicles.

SKILLS:

- ✓ *Employ standard microbiological techniques to isolate and purify phages from environmental samples.*
- ✓ *Observation of plaques on bacterial plates.*
- ✓ *Estimation of plaque forming units (PFU) in a sample.*
- ✓ *Phage typing and imprinting.*

PRACTICES:

- Sequential steps in Production and purification of Fab fragment and sCFV.
- Report on the Phage libraries.
- Application of phages in medicine and phage therapy.
- Report on purification of potential bacteriophages (M13) for E.coli.
- Report on Phages as vaccine delivery vehicles.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Analyze the importance of bacteriophages in development of molecular biology.	Analyze	1	2,4,9,10
2	Apply the structure and biology of certain filamentous/non-filamentous bacteriophages to display proteins/peptides.	Apply	1	1,2,9,10
3	Evaluate the application of phage display technique in recombinant antibody engineering.	Evaluate	2	3,4,9,10
4	Investigate the role of phage display in medicine and health.	Analyze	2	3,4,6,9,10
5	Design experimental outline for in silico expression of peptide/protein on M13 bacteriophage.	Create	1	4,5,9,10

TEXT BOOKS:

1. C R Geyer and S S Sidhu,"Phage display in biotechnology and drug discovery", 2nd edition, CRC Press, 2015.
2. Brian K, Kay, Jill Winter, John McCafferty, "Phage Display of Peptides and Proteins: A Laboratory Manual", 1st edition, Elsevier, 1996.

REFERENCEBOOKS:

1. J.Nicastro, S.Wong, Z. Khazaei, P.Lam, J.Blay and R.A Slavcev,"Bacteriophage Applications-Historical Perspective and Future Potential", 2nd edition, Springer, 2016.
2. P.M.O Brien and R. Aitken, "Antibody Phage Display: Methods and Protocols", 1st edition, Springer, 2004.
3. Carlos F Barbas, Dennis R Burton, Gregg J Silverman, "Phage Display: A Laboratory Manual", 2nd edition, CHSL Press, 2004.

22BT811 PHYTOPHARMA

Source: https://www.ingredientsnetwork.com/frutarom-to-focus-on-phytopharma-news044746.html

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Bioanalytical Techniques, Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course designed to illustrate the importance of secondary metabolites of plants. Screening of phytochemicals from indigenous medicinal plants and its efficacy evaluation. This course provides knowledge on phyto drugs with typical examples as a prelude to design new formulation.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

INDIAN SYSTEM OF MEDICINE

Basic principles of plant taxonomy, agronomic features, medicinally important plant species, Database on medicinal plants.

UNIT-2 **10L+0T+10P=20 Hours**

ANALYSIS OF PHYTOCHEMICALS

Preparation of crude extracts and essential oils, Qualitative and quantitative identification and characterization methods for crude drugs and active phyto compounds, HPTLC, FTIR, GCMS, LCMS, and QSAR and molecular docking.

PRACTICES:

- Preparation of plant crude extract.
- Extraction of phyto compounds from different medicinal plants.
- Screening of phyto chemicals using HPTLC.
- Screening of phyto chemicals using GC-MS.
- Molecular Docking studies.

MODULE -2

UNIT-1 **6L+0T+6P=12 Hours**

THERAPPEUTIC PHYTOCOMPOUNDS

Antimicrobial, anti-inflammatory, antiulcer, antidiabetic, anti-cancer, hepatoprotective and immuno modulatory phytochemicals, Bio-fungicides and biopesticides, Nutraceuticals.

UNIT-2 **10L+0T+10P=20 Hours**

PHYTO DRUGS

Patents, IPR, Breeder's right and biopiracy, Phyto drugs and their mode of action - andrographolide, vinblastine, vincristine, curcumin, cinnamaldehyde, anthocyanins, kaempferol, morindin, berberine, quercetin.

SKILLS:

- ✓ *Preparation of crude extracts and essential oils.*
- ✓ *Identification and separation of phytochemicals.*
- ✓ *Molecular Docking of phytochemicals*

PRACTICES:

- A report on filing a patent.
- Indian legal framework on IPR.
- Case study on Plant breeder's rights.
- Report on ADMET properties of Andrographolide, Vinblastine, Vincristine, Curcumin, Cinnamaldehyde, Anthocyanins, Kaempferol, Morindin, Berberine, Quercetin.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply analytical methodsfor structural elucidation of phytochemicals.	Apply	1	1,2,4,5,9,10
2	Design the combinatorial drugs for specific applications.	Create	1	1,3,4,5,9,10
3	Isolate and evaluate the active compounds from medicinal and aromatic plants.	Evaluate	2	2,4,9,10
4	Develop novel nutraceuticals and cosmetic products.	Create	2	3, 4,9,10

TEXT BOOKS:

1. Trease& Evans, "Pharmacognosy–William Charles Evans", 14th edition, Harcourt Brace, 1989
2. Raymond G Hill, Duncan Richards, "Drug Discovery and Development Technology in Transition", 3rd Edition, Elsevier 2021.

REFERENCEBOOKS:

1. Gunnar Samuelss, "Drugs of Natural Origin, A Textbook of Pharmacognosy", 1st edition, English edition, Swedish Phramaceutical, 1992.
2. W C Evans, "Trease and Evans' Pharmacognosy" ,15th edition, Saunders, 2002.
3. Chaudhary MI, "Frontiers in Drug Design & Discovery", 10th edition, Bentham Science Publishers, 2016.

22BT813 PLANT TISSUE CULTURE AND TRANSGENICS

Source: https://microscopiaiwm.com/tag/transgenic-plants/

Hours Per Week :

L	T	P	C
2	0	2	3

PREREQUISITE KNOWLEDGE: Basics of Biology, Genetic Engineering.

COURSE DESCRIPTION AND OBJECTIVES:

The course describes importance of plant tissue culture for production of haploids, hybrids, artificial seeds and development of transgenic crops tolerant to various abiotic stresses. It also aids in the production of commercial compounds alongside with understanding the regulatory issues.

MODULE-1

UNIT-1 **6L+0T+6P=12 Hours**

PLANT TISSUE CULTURE

Introduction to plant tissue culture, basic steps involved in tissue culture, Initiation and maintenance of callus, Plant acclimatization, Production of haploids, somoclonal variations-causes, advantages and disadvantages, Synthesis of artificial seeds.

UNIT-2 **10L+0T+10P=20 Hours**

TRANSFORMATION TECHNOLOGY

Gene transfer methods-direct and indirect, Agrobacterium mediated gene transfer, vector less or direct DNA, Development of biotic (bacterial resistance, fungal resistance, viral resistance) and abiotic (salt tolerance, Drought tolerance, Heat tolerance, Cold tolerance) stress tolerance crops.

PRACTICES:

- Micropropagation of elite species.
- Genetic transformation of plant tissue using Agrobacterium tumefaciens.
- Preparation of recombinant plant expression vector with gene of interest.
- Confirmation of transgenes by PCR.
- Confirmation of transgenes by Southern blot.

MODULE-2

UNIT-1 **6L+0T+6P=12 Hours**

MOLECULAR FARMING

Genetic engineering for quality improvement - seed storage proteins, essential amino acids, vitamins and minerals, industrial enzymes; Bioplastics, Bioreactor systems and models for mass cultivation of plant cells.

UNIT-2 **10L+0T+10P=20 Hours**

BIOSAFETY GUIDELINES OF GMO'S

Environmental issues associated with transgenic crops, Biosafety guidelines - Government of India; Roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture, Food safety and Environmental release of GMO's-risk analysis, assessment, management and communication.

SKILLS:

- ✓ *Optimization of media components for clonal propagation.*
- ✓ *Genetic improvement of crop plants.*
- ✓ *Biosafety of GMOs.*

PRACTICES:

- Compilation of acreage and yield production of transgenic plants.
- Case studies on effect of GMOs in the ecosystem.

PRACTICES:

- Induction of hairy root cultures using Agrobacteriumrhizogenes for the production of secondary metabolites.
- Induction of somatic embryos preparation of synthetic seeds.
- Elicitation for secondary metabolites using elicitors.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the knowledge of molecular markers for transformation.	Apply	1	1, 6,8,9,10
2	Analyze different plant tissue culture techniques for development of seedlings and transgenic plants.	Analyze	1	2,3,4,5,9,10
3	Investigate the role of elicitors for enhanced production of secondary metabolites.	Analyze	2	3,4,5,9,10
4	Select suitable bioreactors for production of commercial products.	Analyze	2	3,5,6,9,10

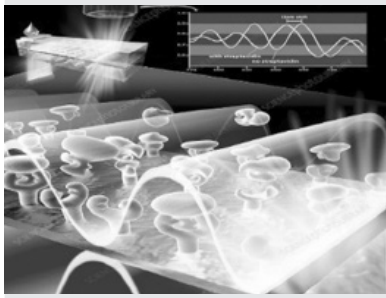
TEXT BOOKS:

1. B B Buchanan, W Gruissem, K Vickers and R L Jones, “Biochemistry and Molecular Biology of Plants”, 2nd edition, Wiley, 2015.
2. H S Chawla, “A Text Book of Plant Biotechnology”, 2nd edition, Oxford, 2002.

REFERENCE BOOKS:

1. Bhojwani, Sant Saran, Dantu and Prem Kumar, “Plant Tissue Culture: An Introductory Text”, 1st edition, Springer, 2013.
2. Adrian Slator, Nigel W. Scott and Mark R. Fowler, “Plant Biotechnology: the genetic manipulation of plants”, 2nd edition, Oxford, 2008.
3. R C Dubey, “A Text Book of Plant Biotechnology”, 4th edition, S. Chand, 2006.

22BT817 BIOSENSORS



Source: https://www.behance.net/gallery/13712465/Molecular-Systems-Biology?tracking_source=search_projects%7Csystems%20biology

Hours Per Week :

L	T	P	C
2	2	0	3

PREREQUISITE KNOWLEDGE: Applied Physics, Nano Biotechnology, Biochemistry and Enzymology.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers an insight into the usage of bio-molecules as recognition elements for detection of a particular analyte and biological elements such as proteins in place of silicon chips. It enlightens the types of biosensors, their working principles and applications in various fields. Further it emphasizes on biomolecular computers and its applications.

MODULE-1

UNIT-1 **6L+6T+0P=12 Hours**

BIOSENSORS

Biosensors-advantages and limitations, various components of biosensors, Bio-catalysis based biosensors, Bio-affinity based biosensors, microorganisms- based biosensors, Biologically active material and analyte, Types of membranes used in biosensor constructions.

UNIT-2 **10L+10T+0P=20 Hours**

TRANSDUCERS

Various types of transducers, Principles and applications - calorimetric, optical, potentiometric/ amperometric, conductometric/resistometric, piezoelectric, semiconductor, impedimetric and chemiluminescence.

PRACTICES:

- Review on analyte detection using bio-catalysis based biosensors in environmental samples.
- Report on design of bio-affinity based biosensors.
- Quiz/debate on commercial diagnostic kits based on biosensors.
- Report on biosensors in industrial process control.

MODULE-2

UNIT-1 **6L+6T+0P=12 Hours**

APPLICATIONS OF BIOSENSORS

Biosensorsin clinical chemistry, medicineand healthcare, veterinary, agriculture, food and environmental monitoring, Low-cost biosensor for industrial processes for online monitoring, Design of enzyme electrodes and their applicationas biosensors in industry, CO_2, O_2, NOx and Air particulate sensors.

UNIT-2 **10L+10T+0P=20 Hours**

BIO-MOLECULAR COMPUTERS

Potential advantages and developments towards a biomolecular computer and molecular arrays as memory stores, Molecular wires and switches, Mechanisms of unit assembly, Assembly of photonic biomolecular memory store, Information processing, Commercial prospects for biomolecular computing systems.

SKILLS:

- ✓ *Immobilization of enzymes and biomolecules on solid platforms.*
- ✓ *Selection of suitable sensing method for detection of specific biomolecules and pathogens.*
- ✓ *Paper based sensors development for detection of analyte*

PRACTICES:

- Report on applications of biosensors for detection of toxins in food industry.
- Review on the different designs of enzyme electrode.
- Debate on pesticide detection methods in environment using biosensors.
- Report on biomolecular computers development worldwide.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply the principles of biosensors for the development of devices.	Apply	1	1,2,9,10
2	Design biosensors for biomedical applications.	Create	1	2,3,4,5,6,9,10
3	Develop biosensors for detection of pollutants in environmental samples.	Create	2	2,3,4,5,9,10
4	Evaluate different types of transducers for development of biosensors.	Evaluate	2	2,3,5,9,10

TEXT BOOKS:

1. B R Eggins, “Chemical sensors and biosensors”, 1st edition, Wiley, 2002.
2. J. Yoon, “Introduction to Biosensors”, 1st edition, Springer, 2013.

REFERENCE BOOKS:

1. V. C. Yang, “Biosensors Theory and Applications”, 1st edition, Plenum, 2000.
2. Loic J Blum and Pierre R Coulet, “Biosensors Principles and Applications”, 1st edition, Marcel Dekker, 1991.
3. Donald G. Buerk, “Biosensors Theory and Applications”, 1st edition, Technomic, 1993.
4. Graham Ramsay, “Commercial Biosensors”, 1st edition, Wiley, 1998.

HONOURS
(OMICS)

BIOINFORMATICS

B.Tech.

22BI951	-	Pharmacogenomics
22BI952	-	Metabolomics
22BI953	-	Comparative and Functional Genomics
22BT953	-	Metagenomics
22BI954	-	Project / Open source – Swayam/NPTEL

COURSE CONTENTS

I SEM & II SEM

22BI951 PHARMACOGENOMICS

source: https://www.dovepress.com/concepts-driving-pharmacogenomics-implementation-into-everyday-healthc-peer-reviewed-fulltext-article-PGPM

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Genomics proteomics, Bioinformatics, computational Biology.

COURSE DESCRIPTION AND OBJECTIVES:

The course provides knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity and deals with how drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.

MODULE-1

UNIT-1 **10L+0T+0P = 10 Hours**

PHARMACOGENOMICS

Pharmacogenetics- roots of pharmacogenomics and it is not just pharmacogenomics, genetic drug response profiles, the effect of drugs on gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, rivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

UNIT-2 **15L+0T+15P= 30 Hours**

HUMAN GENOME

Expressed sequence Tags (EST) and computational biology, microbial genomics, computational analysis of whole genomes, computational genome analysis, genomic differences that affect the outcome of host pathogen interactions, protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, biological complexity. Single nucleotide polymorphisms(SNP's) in pharmacogenomics-approaches, number and types of SNPs, study design for analysis, analytical issues, development of markers

PRACTICES:

- In-silico calculation of drug likeliness of small molecules by using Lipinski rule and ADME Parameters.
- In-silico optimization of pharmacophore.
- Enzyme based inhibition activity IC50 calculation.
- Analysis of biological specifications for drug content and estimation of the pharmaco kinetic parameters.

MODULE-2

UNIT-1 **10L+0T+0P=10 Hours**

DRUG ACTION, TOXICITY AND DESIGN

Platform technologies and pharmaceutical process, its applications to the pharmaceutical industry, understanding biology and diseases, target identification and validation, drug candidate identification and optimization, safety and toxicology studies. Protein structure information, protein structure and variation in drug targets-the scale of problem, mutation of drug targets leading to change in the ligand binding pocket.

UNIT-2 **15L+0T+15P=30 Hours**

ASSOCIATION STUDIES

Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R&D

SKILLS:

- ✓ *Development of bio-therapeutics.*
- ✓ *Application of pharmacogenomics to improve drug delivery.*
- ✓ *Evaluation of pharmacokinetic parameters of drugs*

PRACTICES:

- Report on pharmacogenomics of human P-Glycoprotein.
- Report on study of drug transporters.
- Report on study of lipid lowering drugs.
- Report on study of chemotherapeutic agents for cancer treatment

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply single nucleotide polymorphism as a biomarker for the prediction of risk.	Apply	1	1,5,6,9,10
2	Analyze the genetic differences between individuals.	Analyze	1	2,4,7,9,10
3	Apply and manage the new genomics-based tools for best treatment choices.	Apply	2	1,4,5,9,10
4	Evaluate the therapeutic response and prognosis of malignancies.	Evaluate	2	3,4,5,9,10

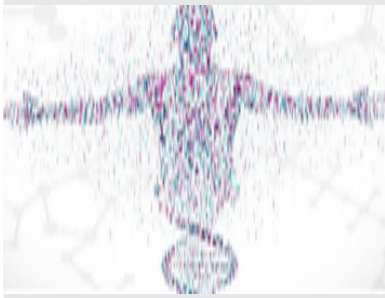
TEXT BOOKS:

1. Martin M.Zdanowicz, M.M, “Concepts in Pharmacogenomics”, 2nd edition, American society of health and pharmacists, 2017.
2. Licinio J and Wong Ma-Li,“Pharmacogenomics:The Search for the Individualized Therapies”, 2nd edition, Wiley-Blackwell, 2009.

REFERENCE BOOKS:

1. Brazeau D.A. and Brazeau G.A, “Principles of the Human Genome and Pharmacogenomics”, 1st edition, American pharmacist association, 2011.
2. Werner K, Meyer U.A and Tyndale R.F, “Pharmacogenomics”, 2nd edition, Taylor and Francis, 2005.
3. Langman L.J and Dasgupta A, “Pharmacogenomics in Clinical Therapeutics”, 2nd edition, Wiley-Blackwell, 2012.

22BI952 METABOLOMICS



source: https://www.futurelearn.com/courses/metabolomics

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Biochemistry and Enzymology, Bioanalytical Techniques.

COURSE DESCRIPTION AND OBJECTIVES:

Metabolomics is an emerging field that aims to measure the complement of metabolites (the metabolome) in living organisms. The course provides an introduction to metabolomics, describes the tools and techniques we use to study the metabolome and explains why we want to study it. By the end of the course you will understand how metabolomics can revolutionize our understanding of metabolism.

MODULE-1

UNIT-1 **15L+0T+0P=15 Hours**

METABOLOME

The metabolome and metabolic reactions, Metabolites and metabolite profiling, Metabolomics -applications and its role in systems biology with case studies, Targeted and untargeted metabolomics, General work flow including quenching and sample preparation.

UNIT-2 **10L+0T+15P=25 Hours**

DATABASES AND BIOANALYTICAL TECHNIQUES

Databases and standardization of reporting methods for metabolic studies, Detection and quantification of metabolites by advanced analytical techniques(NMR/Mass spectroscopy, HPLC), Statistical methods (PCA, PLS, PLS-DA) in metabolomics

.**PRACTICES:**

- Pathway and metabolome databases
- Software tools available for metabolomics analysis
- Review and development of Protocols/workflow.
- Scientific report writing in metabolomics for evaluation.

MODULE-2

UNIT-1 **10L+0T+0P=10 Hours**

CHEMOMETRICS IN METABOLOMICS

Chemo metrics in Metabolomics, Bioinformatics Approaches to Integrate Metabolomics and Other Systems Biology Data, Chemometrics in Metabolomics.

UNIT-2 **20L+0T+10P=30 Hours**

APPLICATIONS OF METABOLOMICS

Introduction to the ARM database; The genome-based E-CELL modeling (GEM) system; Large-scale simulation of metabolism, metabolomics and medical sciences

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SKILLS:

- ✓ *Design a metabolomics workflow.*
- ✓ *Data integration in metabolomics.*
- ✓ *Large scale simulation of metabolism*

PRACTICES:

- Canonicalization of an amino acid.
- Determination of aromaticity.
- Search pathways using MapEditor.
- Develop GEM system by integrating databases

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Evaluate advantages and limitations of some analytical techniques used in metabolomics studies.	Evaluate	1	1,4,5,9,10
2	Identify the appropriate experimental design in a metabolomics study.	Analyze	1	2,3,9,10
3	Analyze the role of metabolomics in drug design.	Analyze	2	2, 4,9,10
4	Design of GEM systems.	Create	2	3,4,5,9,10

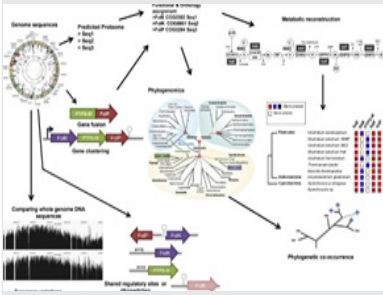
TEXT BOOKS:

1. M. Tomita, and T. Nishioka, “Metabolomics- The Frontier of Systems Biology”, 1st edition, Springer Publications, 2003.
2. Saito K, “Biotechnology in agriculture and forestry: Plant metabolomics”,1st edition, Springer, 2006.

REFERENCE BOOKS:

1. Gasteiger J, Engel T, “Chemoinformatics: a textbook”, 1st edition, John Wiley & Sons; 2006.
2. Nielsen J, Jewett MC, “Metabolomics: a powerful tool in systems biology”, 2nd edition, Springer Science & Business Media; 2007.
3. Lindon JC, Nicholson JK, Holmes E, “The handbook of metabolomics and metabolomics”, 1st edition, Elsevier, 2011.

22BI953 COMPARATIVE AND FUNCTIONAL GENOMICS



source: https://www.sciencedirect.com/topics/neuroscience/comparative-genomics.

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Genomics and proteomics, Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

The course aims at providing comprehensive approaches to understand the genome functions, to develop and promote high throughput and large scale approaches to investigate the function of the genomes, their products and the interactions between the two. This course thus will provide an overview of the concept of Functional Genomics and contemporary approaches used to understand the genome function.

MODULE -1

UNIT-1 **15L+0T+0P = 15 Hours**

FUNDAMENTALS OF GENOMICS

Genome organization of model organism- E. coli, yeast, mice, A. thaliana, human etc. Genome statistics. First and 2nd generation sequencing: Sanger sequencing and next-generation sequencing; Reverse termination sequencing, single-cell RNA sequencing or single-cell RNA sequencing and applications.

UNIT-2 **10L+0T+15P= 25 Hours**

COMPARATIVE GENOMICS

Genome annotation i.e. mining genomic sequence data, gene prediction methods, physical mapping, metagenomics, evolutionary relationship, genome analysis, functional maps (transcriptome, proteome, metabolome) metabolic network maps

.**PRACTICES:**

- Data mining of biological sequences
- Insilico PRIMER Designing
- Gene Prediction Tools .

MODULE -2

UNIT-1 **15L+0T+0P=15 Hours**

FUNCTIONAL GENOMICS TOOLS

Hybridization and sequencing-based approaches. Serial analysis of gene expression-SAGE, DNA-microarray, application of DNA microarray, cDNA-PCR, etc. SNP: SNP technologies: Platforms & analysis haplotyping: concepts and applications and relevance in cancer biology.

UNIT-2 **10L+0T+15P=25 Hours**

REGULATIONOF GENEEXPRESSION

Gene function technologies (gene targeting, gene silencing (RNAi), micro-RNA-human and drosophila biomarkers pharmacogenomics: concepts and applications in health care role of genotype in drug metabolism identification & utilization of cancer bio-marker.

.

SKILLS:

- ✓ *Theoretical analysis of microarray data*
- ✓ *Practical use of upto date functional genomics and rDNA techniques*
- ✓ *Development of functional genomics technologies used in biotech industries*

PRACTICES:

- Report on molecular markers prediction (SSR and SNP)
- Review on tools for expression data analysis.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Apply various genomic technologies to solve biological problems	Apply	1	1,5,6,9,10
2	Access and utilize genome information from databases for practical purposes.	Anlyze	1	1,2,4,9,10
3	Analyze gene expression datasets to derive the biologically meaning information.	Anlyze	2	2,4,5,9,10
4	Apply the knowledge of functional genomics in public health.	Apply	2	1,4,5,6,9,10

TEXT BOOKS:

1. A. Malcolm Campbell, Laurie J. Heyer Discovering Genomics, Proteomics and Bioinformatics. Prentice Hall, 2nd edition, 2002.
2. Andreas D. Baxevanis, B. F. Francis Ouellette, “Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins”, Wiley & Sons, 3rd edition, 2001.

REFERENCE BOOKS:

1. Wren B, DorrellN, “Functional Microbial Genomics: Methods in Microbiology”,1st edition, Academic Press, 2002.
2. Streit, Wolfgang, Daniel and Rolf, “Metagenomics, Methods and Protocols”, 1st edition, springer, 2010.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, “Molecular Biology of the Gene”, 5th edition, Pearson, 2004.

22BT953 METAGENOMICS

Source: Metagenomics - DTU Health Tech

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Microbiology and Fermentation Technology, Bioinformatics.

COURSE DESCRIPTION AND OBJECTIVES:

This course teaches analysis of genetic data from large microbial communities and also allows to gain knowledge on metagenomics experimental design and next-generation sequencing. It allows comparative analyses to understand how genes, pathways, and environmental factors could translate into ecosystem-level knowledge.

MODULE-1

UNIT-1 **15L+0T+0P=15 Hours**

FROM GENOMICS TO METAGENOMICS

Bacterial functional genomics, Genomesequence analysis, The Soil-resistome Project, The Human-Microbiome Project, Cloning the metagenome, Culture-independent access to the diversity and functions of the uncultivated microbial world, 16S and 18S analysis, Antibiotic resistance sequence detection.

UNIT-2 **10L+0T+15P=25 Hours**

BIOINFORMATICS ANALYSIS OF METAGENOMICS DATA

MGmapper, Qiime2, ResFinder database, Metagenomic classification using KRAKEN, Analysis and visualization of read countdata, Metagenomic assembly and binning - reconstructing genomes from reads, Application of metagenomics insurveillance - methods, Meta transcriptomics.

PRACTICES:

- 16S Microbial Analysis with mothur workflow.
- Antibiotic resistance sequence detection.
- Meta transcriptomics analysis using microbiome RNA-seqdata.
- Assembling the metagenomes (SqueezeMeta).

MODULE-2

UNIT-1 **15L+0T+0P=15 Hours**

METAGENOMICS DATA ACQUISITION

Mapping on databases (Silva, GreenGenes, NCBI), Hypervariable regions of ribosomal RNA and full genome databases, Mapping to a reference database, Generating the Abundance Table, Hypervariable regions(HVRs), Batch Effect Correction, Non-significant reads, Normalization, Sequencing depth & classification, Microbiome variability, Composition based on amplicon sequencing (DADA2 pipe line).

UNIT-2 **10L+0T+15P=25 Hours**

NGS FOR METAGENOMIC SEQUENCING ANALYSIS

Quality Check & Filtering (FastQC, Cutadapt), Prepare mapping file containing features and barcodes - Demultiplexing and quality filtering sequence reads-OTU sidentification (Qiime), Diversity Analysis, Taxonomic composition and relative abundance plots, Taxonomic Heatmap Analysis, Estimation of species richness and sampling depth analysis, Species enrichment plots for eachs ample (KRONA).

SKILLS:

- ✓ *Conduction of computational quality check on metagenomics data.*
- ✓ *Analysing microbiome using mothur workflow and Qiime2.*
- ✓ *Perform Meta transcriptomics using RNA-seq data*

PRACTICES:

- Taxonomic binning of the communities (NR,COG, KEGG Data base)-Cluster edintogenome bins-Bin refinement-Visualize the community and the extractedbins (RandAnvio).
- Find the abundance of the draft genomes (bins) across the samples-Re-assemble the consolidated binset & Visualization the bin.
- Determine the taxonomy of each bin-Functional annotation of bins-Path way enrichment-Phylogenetic analysis.
- Brain-GutAxis: how is the gutmicrobiome affected by diet and does it have an effec to nanxiety a part from the dietitself? How can donor microbiomes help tackle this psychological and physiological condition.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Adopt appropriate insilico platforms for metagenomic analysis.	Apply	1	2,4,5,9,10
2	Evaluate the metagenomic data to study taxonomic diversity, functional potential, and ecological relevance of microbial communities.	Evaluate	1	1,3,6,7,9,10
3	Analyze the public datasets to identify the commensal microbiome.	Analyze	2	2,4,5,9,10
4	Apply NGS in analysis of community microbial genome.	Apply	2	1,2,4,7,9,10

TEXT BOOKS:

1. Jonathan H. Badger, Pauline C. Ng, J. Craig Venter, Karen E. Nelson, “Metagenomics of the Human Body” 1st edition, Springer-Verlag New York, 2011.
2. Streit,WR, DanielR, “Metagenomics”,1st edition, Springer New York, 2017.

REFERENCE BOOKS:

1. Wren B Dorrell N, “Functional Microbial Genomics Methods in Microbiology”, 1st edition, Academic PressInc., 2002.
2. Kalia VC, Shouche Y, Purohit HJ, Rahi P, “Mining of microbial wealth and metagenomics”, 1st edition, Springer, 2017.
3. Norman Grossblatt, “The new science of metagenomics”, 1st edition, National Academic Press, Washington, 2007.
4. Chopra RS, Chopra C, Sharma NR, “Metagenomics: Techniques, Applications, challenges and opportunities”, 1st edition, Springer, 2020.