

SEMESTER III

3BSC201	Mathematics III	2 L	2 Credit
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Module: 1 Probability

Probability spaces, conditional probability, independence, Bayes' rule, Discrete & Continuous random variables and their properties, Independent random variables, the multinomial distribution, Probability distributions: Binomial, Poisson and Normal distributions, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Chebyshev's Inequality.

Module: 2 Statistics

Basic Statistics, Measures of Central tendency: Moments, Skewness and Kurtosis, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Suggested Text/Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Co

Course Code: 3BSC202	Hour Per Week			Hours	Credits
	L	T	P		
Course Title : Biology	3	0	0	3	3

Module 1. (2 hours)- Introduction

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification

Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegans, A. Thaliana, M. musculus

Module 3(4 hours)-Genetics

Purpose: To convey that “ Genetics is to biology what Newton’s laws are to Physical Sciences”

Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be given not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4 (4 hours)-Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5 (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme

catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6 (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose:How to analyses biological processes at the reductionistic level
Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8 (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of K_{eq} and its relation to standard free energy.

Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9.(3 hours)- Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

References:

- 1)Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
- 2)Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
- 3)Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
- 4)Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
- 5)Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Course Outcomes

After studying the course, the student will be able to:

- Describe how biological observations of 18th Century that lead to major discoveries.
- Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
- Classify enzymes and distinguish between different mechanisms of enzyme action.
- Identify DNA as a genetic material in the molecular basis of information transfer.
- Analyse biological processes at the reductionistic level
- Apply thermodynamic principles to biological systems.
- Identify and classify microorganisms.

3ESC201	Analog Electronic Circuits	3L:0T:0P	3 credits
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Course Outcomes:

At the end of this course, students will demonstrate the ability to

Understand the characteristics of transistors.

Design and analyse various rectifier and amplifier circuits.

Design sinusoidal and non-sinusoidal oscillators.

Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode circuits (4 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)

Structure and I- V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common- emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Module 3: MOSFET circuits (8 Hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 5: Linear applications of op-amp (8 Hours)

Idealized analysis of op-amp circuits. Inverting and non- inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Module 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.

J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.

J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.

P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.

P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

3ESC201P	Analog Electronic Circuits Lab	0L:0T:4P	2 Credit
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Analog Electronic Circuits Laboratory

Hands-on experiments related to the course contents of **3ESC201**.

3PCCCS201	Data Structure & Algorithms	3L:0T: 0P	3 credits
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Objectives of the course:

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures

Detailed contents:**Module 1:**

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Module 2:

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3:

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4:

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

“Fundamentals of Data Structures”, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

- Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
- “How to Solve it by Computer”, 2nd Impression by R.G. Dromey, Pearson Education.

Course outcomes

For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.

For a given Search problem (Linear Search and Binary Search) student will able to implement it.

For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.

Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.

Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

3PCCCS202	Computer &Architecture	Organization	3L:0T:0P	3 Credits
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Objectives of the course:

To expose the students to the following:

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on micro programming
- Concepts of advanced pipelining techniques.

Detailed contents:

Module 1

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU—registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

Module 2:

Introduction to x86 architecture.

CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.

Memory system design: semiconductor memory technologies, memory organization.

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers—program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes—role of interrupts in process state transitions, I/O device interfaces – SCII, USB

Module 3:

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Module 4:

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Suggested books:

“Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

“Computer Organization and Embedded Systems”, 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Suggested reference books:

“Computer Architecture and Organization”, 3rd Edition by John P. Hayes,
WCB/McGraw-Hill

“Computer Organization and Architecture: Designing for Performance”, 10th Edition
by William Stallings, Pearson Education.

“Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and
Harry F. Jordan, Pearson Education.

Course outcomes

1. Draw the functional block diagram of a single bus **architecture of a computer and describe the function of the** instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set.
2. **Write** assembly language program for specified microprocessor for computing 16 bit multiplication, division and I/O device interface (ADC, Control circuit, serial port communication).

Write a flowchart for Concurrent access to memory and cache coherency in **Parallel Processors** and describe the process.

Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.

Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism and RISC methodology

HSMC201	Effective Technical Communication	3L:0T:0P	3 Credit
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Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, usability, Human factors, Managing technical communication projects, time estimation, single sourcing, localization.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, creativity.

Text/Reference Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213)