Computer Graphics

Course code: BCT151 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3	2	1	60		40	50	150	

Course Description: This course introduces the fundamental principles of computer graphics and animation, including graphical transformations, rendering techniques, and animation concepts. It covers both 2D and 3D graphics, modeling, viewing, lighting, and animation techniques. The course emphasizes practical implementation and use of modern tools for creating visual content.

Course Objectives:

Upon completion of this course, students will be able to:

- Learn 2D and 3D transformations and viewing techniques
- Apply rendering and shading techniques
- Understand animation principles and methods
- Develop graphical applications and simple animations
- Gain exposure to modern graphics tools and frameworks

Unit 1: Introduction to Computer Graphics **(7 hrs.)**

1.1 Computer Graphics
1.2 Applications of Computer Graphics
1.3 Graphics System (Hardware and Software)
1.4 Types of Computer Graphics
1.5 Input Devices
1.6 Display Devices (CRT, LCD, LED)
1.7 Raster-Scan System and Random Scan System
1.8 CRT Color: Beam Penetration and Shadow Mask Method
1.9 Image Fundamentals: Pixel, Resolution, Aspect Ratio, Refresh Rate, Bit Depth (Color Depth), Pixel Density and Frame Buffer

Unit 2: Chapter 2 : Scan-Conversion **(6 hrs.)**

2.1 Line Drawing Algorithm: Direct, DDA, Bresenham Line
2.2 Circle and Ellipse: Mid-Point Algorithm

Unit 3: 2D Graphics and Transformations **(7 hrs.)**

3.1 2D Translation, Rotation, Scaling, Reflection, Shear Transforms
3.2 2D Composite Transformation
3.3 Window and Viewport
3.4 2D Viewing Pipeline
3.5 2D Viewing Transformation
3.6 Clipping:
  3.6.1 Point Clipping, Line Clipping (Cohen-Sutherland Algorithm)
3.7 Liang-Barsky Line Clipping
3.8 Polygon Clipping

Unit 4: 3D Graphics and Transformations **(6 hrs.)**

4.1 3D Coordinate Systems
4.2 3D Transformations
  4.2.1 Translation, Rotation, Scaling, Reflection, Shear Transforms
  4.2.2 3D Composite Transformation
4.3 Projection: Parallel Projection, Perspective Projection
4.4 3D Viewing Pipeline

Unit 5: Visible Surface Detection and Rendering **(6 hrs.)**

.1 Hidden Surface Removal Techniques:
  .1.1 Back-face Culling
  .1.2 Z-buffer Algorithm
4.5 Illumination Models:
  .1.3 Ambient, Diffuse
  .1.4 Specular Reflection
4.6 Shading Techniques:
  .1.5 Flat Shading
  .1.6 Gouraud Shading
  .1.7 Phong Shading

Unit 6: Color Models and Graphics Standards **(4 hrs.)**

6.1 Color Models:
  6.1.1 Additive color model, Subtractive color model, RGB, CMY/CMYK, HSV,
6.2 Graphics Standards:
  6.2.1 OpenGL (basic introduction), APIs and libraries

Unit 7: Introduction to Animation **(6 hrs.)**

6.3 Principles of Animation
6.4 Types of Animation:
  6.4.1 2D Animation 3D Animation
  6.4.2 Keyframe Animation
  6.4.3 Tweening (In-betweening)
6.5 Animation Techniques:
  6.5.1 Frame-by-frame
  6.5.2 Procedural Animation

Unti 8: Advanced Topics in Graphics and Animation **(3 hrs**.)

8.1 Modeling and Rendering
8.2 Game Graphics
8.3 Virtual Reality (VR)
8.4 Augmented Reality (AR)
8.5 Graphics Engines

Practical Work:

Laboratory work will focus on implementing basic graphics algorithms and creating simple animations. Students will implement line and circle drawing algorithms, perform 2D and 3D transformations, and apply clipping and viewing techniques using programming. They will also use graphics libraries such as OpenGL and develop simple animation projects using appropriate tools or software. At the end of the course, students will complete a mini project involving graphics and animation.

SN	Title
1.	Implementation of Line Drawing Algorithms DDA and Bresenham's Line Algorithm
2.	Implementation of Mid-point Circle Drawing Algorithms
3.	2D Transformations Implementation : Translation, Rotation, Scaling, Reflection, Shearing
4.	Implementation of Cohen-Sutherland Line Clipping
5.	3D Transformations and Projection : Translation, Rotation, Scaling, and Perspective Projection
6.	Develop a graphical project (student-selected or instructor-assigned) and present it with a demonstration as part of the laboratory report. Hint 2D Animation Project , Simple Game Development.

References:

1. Hearn and Baker, Computer Graphics, Prentice- Hall of India Private Limited.
2. Computer Graphics C Version – Donald Hearn & M. Pauline Baker Publisher: Pearson
3. Computer Graphics Principles and Practice – James D. Foley et al. Publisher: Addison-Wesley

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit	Hours	Marks Distribution*
1	**7**	10
2	**6**	8
3	**7**	10
4	**6**	8
5	**6**	8
6	**4**	5
7	**6**	6
8	**3**	5
Total	**45**	**60**

Note: *There may be minor deviation in marks distribution.

Engineering Economics

Course code: BCTSH152 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3		1	60		40		150	

Course Description: The course covers foundational concepts like the time value of money, cash flow diagrams, and interest calculations (simple, compound, nominal, effective). Course also includes engineering projects using methods such as net present value (NPV), internal rate of return (IRR), present/future/annual worth, payback periods, and break-even analysis. It covers topic like depreciation, taxes, inflation, risk assessment, replacement decisions, and cost-benefit comparisons for mutually exclusive alternatives.

Course Objectives:
Upon completion of this course, students will be able to:
- Apply economic principles to engineering decision-making
- Evaluate costs, benefits, and financial feasibility of IT projects
- Analyze alternatives using standard economic evaluation techniques
- Incorporate risk, uncertainty, and inflation in engineering decisions

Unit 1: Introduction to Engineering Economics (3 hrs.)
1.1 History & Principles of engineering economics.
1.2 Role of engineers in Decision making
1.3 Notation and cash flow diagram.

Unit 2: Cost Concept (4 hrs.)
2.1 The elements of cost
2.2 Classification of cost: Fixed Cost , Variable cost , Marginal Cost ,Overhead cost, Prime cost,
2.3 Cost variance analysis
2.4 Demand and Supply

Unit 3.Time Value of Money (7 hrs.)
3.1 Introduction
3.2 Simple Interest, Compound Interest
3.3 Interest Formulae (Nominal Interest rate, Effective Interest rate, Continuous Compounding)
3.4 Economic Equivalence
3.5 The Five Types of Cash flows.

Unit 4. Methods of Engineering Economic Analysis (6 hrs.)
4.1 Determining minimum attractive rate of return (MARR).
4.2 Payback period method
4.3 Equivalent worth methods (Present worth Method, Future worth Method, and Annual worth Method.)
4.4 Rate of return methods (internal rate of return method and external rate of return method)
4.5 Benefit cost ratio method
4.6 Micro and Macro Economics.

Unit 5. Analysis of Alternatives (6 hrs.)
5.1 Comparison of mutually exclusive alternatives having same useful life (payback period method and equivalent worth method, rate of return methods and benefit cost ratio method)
5.2 Comparison of mutually exclusive alternatives having different useful lives (repeatability assumption, co- terminated assumption and capitalized worth method.

Unit 6: Replacement Analysis (5 hrs.)
6.1 Meaning and need for replacement analysis.
6.2 Factors to be considered in replacement analysis.
6.3 Determining economic life of a new and existing assets.
6.4 Comparison of useful life of new and existing assets.
6.5 Comparison of mutually exclusive alternatives.

Unit 7: Risk Analysis (6 hrs.)

7.1 Introduction
7.2 Project risks Analysis
7.2.1 Sensitivity analysis,
7.2.2 Scenario analysis,
7.2.3 Breakeven analysis.
7.3 Projects operating under conditions of certainty and uncertainty
7.4 Decision tree.

Unit 8: Inflation, Depreciation and Income Taxes (8hrs.)

8.1 Concept of inflation.
8.2 Impact of inflation on economic evaluation
8.3 Depreciation concept and terminology
8.4 Methods of depreciation
8.4.1 Straight line method
8.4.2 Declining balance method
8.4.3 Sinking fund method
8.4.4 Sum of the year digit method
8.4.5 Modified accelerated cost recovery system (MACRS))
8.5 Introduction to income tax & types

References:

1. Damodar Adhikari: "Engineering Economics".
2. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall Inc, India.
3. J. L. Riggs, D. D. Bedworth, and S.U. Randhawa, "Engineering Economics",Tata MCGraw Hill Education Private Limited, India.
4. W.G. Sullivan, J. A. Bontadelli, and E.M.Wicks, "Engineering Economy", Pearson Education Asia, India.

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit	Hours	Marks Distribution*
1	**3**	3
2	**4**	3
3	**7**	8
4	**6**	10
5	**6**	8
6	**5**	10
7	**6**	10
8	**8**	8
Total	**45**	**60**

Note: *There may be minor deviation in marks distribution.

Data Communication

Course code: BCTEX153 | **Credit Hours: 3**
Year: III | **Semester: I**
Level: Bachelor | **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3	2	1	60		40	50	150	

Course Description: This course covers the fundamentals of data communication and computer networks, including data transmission, communication models, and network architectures. It addresses the OSI and TCP/IP models, transmission media, switching, routing, basic networking protocols, different network types, error control, and network security basics, equipping students to understand and analyze modern communication systems.

Course Objectives:
Upon completion of this course, students will be able to:
- Understand the fundamental concepts of data communication and its importance in computer engineering and networking
- Understand the key principles, protocols and technologies used for reliable data transmission between devices and networks
- Understand different signals and their characteristics, transmission media and the basics of multiplexing and switching

Unit 1: Introduction **(5 hrs.)**

1.1 Data Communication Terminology and Applications
1.2 Evolution of Data Communication Systems
1.3 Analog and Digital Data Transmission
1.4 Standard Organizations
1.5 Transmission Modes
1.6 Data transmission techniques: Parallel and Serial transmission

Unit 2: Signals and Systems **(6 hrs.)**

2.1 Signals and their classification: Periodic and non-periodic signals, Deterministic and Random signals; Energy and Power signals; Continuous and Discrete time signals
2.2 System: Continuous and Discrete time system
2.3 Basic System Properties: Linearity, Causality, Stability, Static & Dynamic, and Time Invariance
2.4 Basic Signals: Unit Step Signal, Ramp Signal, Impulse Signal, Sinusoidal Signal, Signum Signal
2.5 LTI System

Unit 3: Transmission Media **(8 hrs.)**

3.1 Electromagnetic Spectrum for Communication and Type of Propagation
3.2 Guided Transmission Media: Copper Media (Twisted pair and Co-axial) and Fiber Optics
3.3 Unguided Communication Bands and Antennas
3.4 Unguided Transmission Media: Terrestrial Microwaves, Satellite Communication, VSAT and Cellular System
3.5 Data Rate Limits: Nyquist Bit Rate for Noiseless Channel, Shannon Capacity for Noisy Channel
3.6 Performance of Channel: Bandwidth, Throughput, Latency, Jitter, Bit Error Rate (BER)

Unit 4: Error Handling and Data Compression **(6 hrs.)**

4.1 Attenuation & Distortion, Delay Distortion, Noise & Types, Interference, Crosstalk
4.2 Types of Error & its Detection and Correction Methods: Parity, Check Sum, Cyclic Redundancy Check, Hamming Code
4.3 Data Compression: Lossy (Predictive Coding and Transform Coding) and Lossless Compression (Run Length Coding, Dictionary Coding and Huffman Coding)

Unit 5: Multiplexing and Switching **(7 hrs.)**

5.1 Multiplexing and Application
5.2 Frequency Division Multiplexing (FDM), Wavelength-Division Multiplexing (WDM), Time Division Multiplexing (TDM)
5.3 Spread Spectrum: DHSS, FHSS, Code-Division Multiple Access (CDMA)
5.4 Switching and Application
5.5 Circuit Switching and Packet Switching
5.6 Datagram Switching and Virtual Circuit Switching

Unit 6: Data Encoding and Modulation **(7 hrs.)**

6.1 Line Coding: Unipolar, Polar and Bipolar Signaling
6.2 Digital Modulation Techniques: Amplitude, Frequency, and Phase Shift Keying
6.3 Analog to Digital Conversion: Pulse Code and Delta Modulation
6.4 Analog Modulation Techniques: Amplitude, Frequency, and Phase Modulation
6.5 Multilevel Modulation - QPSK, QAM

Unit 7: Cellular Communications Technology **(6 hrs.)**

7.1 Evolution of Cellular Networks
7.2 Fundamental Terminology: Cell, Frequency-Reuse, Cluster, Adjacent Cell Interference, Co-Channel Interference
7.3 Handoff Strategies
7.4 Architecture of GSM

Practical:

Laboratory work in the initial stage will focus on practicing and verifying the programming concepts learned in class.

SN	Title
1.	Signal Analysis using MATLAB
2.	Implementation of Error Detection Techniques
3.	Simulated simple PCM coder that converts samples into a digital code
4.	Amplitude Modulation and Demodulation
5.	Frequency Modulation and Demodulation
6.	Simulated Error Control Coding Techniques

References:

1. Stallings, W. (2007), Data and Computer Communications, India: Pearson Education
2. Forouzan, B. A., Fegan, S. C. (2007), Data Communications and Networking (McGraw-Hill Forouzan Networking), United Kingdom: McGrawHill Higher Education
3. Tanenbaum, A. S., Wetherall, D. (2011), Computer Networks, India: Pearson Prentice Hall
4. Rappaport, T. S. (2024), Wireless Communications: Principles and Practice, United Kingdom: Cambridge University Press

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit	Hours	Marks Distribution*
1	**5**	6
2	**6**	8
3	**8**	12
4	**6**	8
5	**7**	9
6	**7**	9
7	**6**	8
Total	**45**	**60**

Note: *There may be minor deviation in marks distribution.

Computational Simulation and Modeling

Course code: BCT154 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3	2	1	60		40	50	150	

Course Description: This course introduces the principles and techniques of modeling and simulation for analyzing complex systems. It covers system modeling, simulation methodologies, random number generation, statistical analysis, and simulation languages/tools. Students will learn how to design, implement, and analyze simulation models for real-world problems.

Course Objectives:

Upon completion of this course, students will be able to:

- Understand the concepts of system modeling and simulation
- Learn different types of simulation techniques
- Apply statistical methods in simulation and develop and evaluate simulation models
- Use simulation tools for real-world applications

Unit 1: Introduction to Modeling and Simulation **(8 hrs.)**

1.1 System and System Environment
1.2 Components of System
1.3 Discrete and Continuous System
1.4 System Simulation
1.5 System Modeling
1.6 Types of Models
1.7 Use of Differential and Partial Differential Equations in Modeling
1.8 Advantages, Disadvantages and Limitations of Simulation
1.9 Application Areas
1.10 Phases in Simulation Study
1.11 Calibration and Validation
1.12 Monte Carlo Simulation Method

Unit 2: Continuous System Simulation **(7 hrs.)**

2.1 Continuous System Models
2.2 Representation using Differential Equations
2.3 Analog and Digital Simulation Concepts
2.4 Hybrid Simulation (Analog + Digital)
2.5 Continuous System Simulation Languages (CSSLs)
2.6 Feedback Systems and Examples

Unit 3: Discrete Event Simulation **(10 hrs.)**

3.1 Concept of Discrete Events
3.2 Time Representation
  3.2.1 Event-driven
  3.2.2 Time-driven Simulation
3.3 Event Scheduling and Event List
3.4 Generation of Arrival Patterns
3.5 Simulation of a Telephone System
3.6 Delay Calls
3.7 Performance Measures
  3.7.1 Waiting Time, Utilization, Throughput
3.8 Gathering Statistics
3.9 Counters and Summary Statistics

3.10 Measuring Utilization and Occupancy
3.11 Recording Distribution and Transit Times
3.12 Discrete Simulation Languages

Unit 4: Analysis of Simulation Output **(8 hrs.)**

4.1 Estimation Methods
4.2 Simulation Run Statistics
4.3 Replication of Runs
4.4 Elimination of Internal Bias

Unit 5: Simulation Languages and Tools **(10 hrs.)**

5.1 Classification of Simulation Languages
5.2 Features of Simulation Software
5.3 Introduction to Discrete Simulation Languages
5.4 GPSS (General Purpose Simulation System) Concepts
5.5 Entities, Transactions, Resources
5.6 Basic GPSS Blocks and Programs
5.7 Applications of GPSS
5.8 SIMSCRIPT

Practical Work:

Laboratory work will focus on developing simulation models and analyzing systems. Students will generate random numbers and variables, perform statistical tests on data, implement Monte Carlo methods, and develop discrete event simulation models. They will also use tools such as Python (SimPy), AnyLogic, MATLAB to build and analyze simulations. At the end of the course, students will complete a mini project based on real-world scenarios or perform below labs

SN	Title
1.	Queue Simulation (Bank/Server system) • Simulation of Single Server Queuing System. • Simulation of Two-Server Queuing System
2.	Monte-Carlo Simulation.
3.	Simulation using GPSS / Simulation Tools
4.	Traffic Simulation /Telephone call

References:

1. J.A Spriest and G.C Vansteenkiste, Computer-Aided Modeling and Simulation, Academic Press.
2. G. Gorden, System Simulation, Pretice Hall of India.
3. A.M Law and W.D. Kelton, Simulation Modeling and Analysis, McGraw Hill.
4. Simulation Modeling and Analysis – Averill M. Law Publisher: McGraw-Hill
5. Discrete Event System Simulation – Jerry Banks Publisher: Pearson

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit	Hours	Marks Distribution*
1	**8**	12
2	**8**	12
3	**10**	12
4	**8**	12
5	**10**	12
Total	**45**	**60**

Note: *There may be minor deviation in marks distribution.

Probability and Statistics

Course code: BCTSH155 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours/ Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3	-	2	60	-	40	-	100	

Objective: The objective of the course is to provide students with a clear understanding of the basic statistical concepts and tools and to enable them to use these tools as Necessary Avenue for engineering professions and scientific knowledge.

1. Introduction to Statistics and Data Description (6 hours)
   - 1.1 Graphical Presentation of Data: Dot Plots and Scatter Plots, The frequency Distribution and Histogram, The Stem-and-leaf Plot, The Box Plot, The Pareto Chart
   - 1.2 Numerical Description of Data:
     - 1.2.1 Measures of Central Tendency: Mean, Median, Mode, Mean of combined groups, Comparison of mean, median and mode
     - 1.2.2 Measures of Dispersion: Range, Quartile deviation, Standard deviation& Variance, Coefficient of Variation, Skewness and Kurtosis
2. Probability (6 hours)
   - 2.1 Introduction
   - 2.2 A Review of Sets
   - 2.3 Random experiment, Sample space and Events (simple and composites), Mutually exclusive and Collectively exhaustive events, Independent events
   - 2.4 Probabilities definition and Assignment
   - 2.5 Finite Sample Space and Enumeration
   - 2.6 Conditional probability
   - 2.7 Partitions, Total probability, and Bayes' theorem and its applications
3. Random Variables and Mathematical Expectation (3 hours)
   - 3.1 Introduction to Random Variables: Definition of random variables, Types: Discrete and Continuous random variables
   - 3.2 Distribution Function: Cumulative Distribution Function (CDF), Probability Mass Function (PMF), Probability Density Function (PDF)
   - 3.3 Characteristics of Distributions: Mean (Expected value), Variance and Standard Deviation
   - 3.4 Functions of Random Variables: Function of discrete random variable, Function of continuous random variable
   - 3.5 Mathematical Expectation: Definition and properties, Expectation of functions of random variables
4. Discrete Probability Distributions (4 hours)
   - 4.1 Introduction
   - 4.2 Bernoulli Trials and the Bernoulli Distribution
   - 4.3 The Binomial Distribution
     - 4.3.1 Mean and variance of Binomial Distribution
     - 4.3.2 The cumulative Binomial Distribution
     - 4.3.3 An application of Binomial Distribution

4.4 The Poisson Distribution

4.4.1 Mean and variance of Poisson Distribution

4.4.2 The Poisson Approximation to Binomial Distribution

5. The Normal Distribution (4 hours)

5.1 Introduction

5.2 Properties of the Normal Distribution

5.3 The Mean and Variance of the Normal Distribution

5.4 The Normal Cumulative Distribution

5.5 The Standard Normal Distribution

5.6 Problem-Solving Procedure

5.7 The Central Limit Theorem

5.8 The Normal Approximation to Binomial Distribution

6. Random Samples and Sampling Distributions (3 hours)

6.1 Population and sample, Census and sampling, Estimate and estimator, Parameter and statistic

6.2 Random Samples

6.3 Statistics and Sampling Distributions

6.4 The Chi-Square Distribution

6.5 The t-Distribution

6.6 The F-Distribution

7. Estimation (4 hours))

7.1 Point Estimation, Interval estimation

7.2 Properties of Estimators

7.3 Single-Sample Confidence Interval Estimation (mean and variance)

7.4 Two-Sample Confidence Interval Estimation (mean and variance)

8. Tests of Hypotheses (6 hours))

8.1 Introduction

8.2 Tests of Hypotheses on a Single-Sample (mean and variance)

8.3 Tests of Hypotheses on two Samples (mean and variance)

9. Simple Linear Regression and Correlation (4 hours))

9.1 Simple Linear Regression and interpretation

9.2 Correlation and interpretation

9.3 Coefficient of determination

10. Statistical Quality Control (4 hours))

10.1 Introduction, Statistical Process Control

10.2 Control Charts for Measurements

10.3 Control Charts for Individual Measurements

10.4 Control Charts for Attributes

Tutorial **(30 hours)**

1 Construct and interpret graphical representations of data (dot plot, histogram, box plot, scatter plot, Pareto chart)

2 Compute measures of central tendency (mean, median, mode) and dispersion (range, variance, standard deviation, CV)

3 Analyze datasets using skewness and kurtosis

4 Solve problems based on basic probability concepts and set operations

5 Solve problems involving sample space, events, and types of events

6 Apply conditional probability, total probability, and Bayes’ theorem

7 Work with discrete and continuous random variables and compute mean and variance
8 Solve problems involving expectation and functions of random variables
9 Solve problems based on Bernoulli, binomial, and Poisson distributions
10 Solve problems using normal distribution and standard normal tables
11 Apply central limit theorem and normal approximation
12 Analyze sampling distributions and apply Chi-square, t, and F distributions
13 Construct confidence intervals for single and two samples
14 Perform hypothesis testing for single and two samples
15 Compute and interpret correlation and regression analysis
16 Construct and interpret statistical quality control charts

References:

1. Probability and Statistics in Engineering, 4th Edition, by William W.Hines, DouglasC. Montgomery, David M. Goldsman, and Connie M. Borror, John Wiley and Sons, Inc, 2003.

2. Miller & Fruend's Probability and Statistics for Engineers by Richard A Johnson

3. Statistics Concepts and Application by Nabendu Pal and Sahadeb Sarkar, Prentice Hall of India Private Limited, 2005

3. Probability and Statistics by Purna Chandra Biswal, PrenticeHall of India Private Limited, 2005

4. Modern Elementary Statistics by John E. Freund, 6th edition, Prentice Hall Int.

5. Statistics for Management by R. I. Levin and D. S. Rubin, 6th edition

Evaluation Scheme:

The questions will cover all the chapters of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	**Hours**	**Marks Distribution***
1.	7	11
2.	6	8
3.	3	4
4.	4	5
5	4	5
6	3	4
7	4	5
8	6	8
9	4	5
10	4	5
Total	**45**	**60**

* There may be minor deviation in marks distribution.

Operating System

Course code: BCT156 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3	2	1	60		40	50	150	

Course Description: This course introduces the fundamental concepts of operating systems, focusing on process management, memory management, file systems, and system security. It explains how an operating system acts as an interface between users and hardware, managing system resources efficiently. The course also includes practical exposure to system-level programming and OS utilities.

Course Objectives:

Upon completion of this course, students will be able to:

- Understand the structure and functions of operating systems
- Learn process and thread management techniques
- Understand CPU scheduling and synchronization
- Explore memory management and virtual memory
- Study file systems and I/O management and security and modern OS trends

Unit 1. Principles of Operation Systems **(7 Hrs.)**

1.1 Definition and Functions of Operating System
1.2 Evolution of Operating Systems
1.3 Types of OS:
  1.3.1 Batch
  1.3.2 Interactive
  1.3.3 Multiprocessing
  1.3.4 Time-sharing
  1.3.5 Distributed
  1.3.6 Real-time
  1.3.7 User and operator driven OS
1.4 Operating System Components
1.5 Operating System Structure:
  1.5.1 Monolithic
  1.5.2 Layered
  1.5.3 Micro-Kernel
  1.5.4 Client-Server
  1.5.5 Virtual Machine
1.6 Operating System Services
1.7 Context Switching (Kernel mode and User mode)
1.8 System Calls
1.9 Introduction to Shell Program and Commands

Unit 2: Process Management and Synchronization **(10 hrs.)**

2.1 Process vs Program
2.2 Multiprogramming
2.3 Process Model, Process States
2.4 Process Control Block
2.5 Threads
2.6 Thread vs Process
2.7 User and Kernel Space Threads
2.8 Inter Process Communication and Synchronization
2.9 Race Condition
  2.9.1 Critical Section

- 2.9.2 Implementing Mutual Exclusion
- 2.9.3 Mutual Exclusion with Busy Waiting (Disabling Interrupts, Lock Variables, Strict Alteration, Peterson's Solution, Test and Set Lock)

2.10 Mutual Exclusion
- 2.10.1 Sleep and Wakeup
- 2.10.2 Semaphore
- 2.10.3 Monitors
- 2.10.4 Message Passing

2.11 Classical IPC Problems:
- 2.11.1 Producer Consumer, Sleeping Barber, Dining Philosopher Problem

2.12 Process Scheduling
- 2.12.1 Batch System Scheduling (First-Come First-Served, Shortest Job First, Shortest Remaining Time Next)
- 2.12.2 Interactive System Scheduling (Round-Robin Scheduling, Priority Scheduling, Multiple Queues)

2.13 Real Time System Scheduling

Unit 3: Process Deadlocks **(6 hrs.)**

3.1 Introduction
3.2 Deadlock Characterization
3.3 Preemptable and Non-preemptable Resources
3.4 Resource Allocation Graph
3.5 Conditions for Deadlock
3.6 Handling Deadlocks:
- 3.6.1 Ostrich Algorithm, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit 4: Memory Management **(8 hrs.)**

4.1 Definition
4.2 Monoprogramming vs Multi-programming
4.3 Modeling Multiprogramming
4.4 Fixed and Variable Partitions
4.5 Relocation and Protection
4.6 Memory Management (Bitmaps & Linked list)
4.7 Memory Allocation Strategies
- 4.7.1 Virtual Memory:
  - 4.7.1.1 Paging, Page Table, Page Table Structure
  - 4.7.1.2 Handling Page Faults, TLB

4.8 Page Replacement Algorithms
- 4.8.1 FIFO, Second Chance, LRU, Optimal, LFU, Clock, WS-Clock

4.9 Concept of Locality of Reference
4.10 Belady's Anomaly
4.11 Segmentation
- 4.11.1 Need of Segmentation
- 4.11.2 Drawbacks
- 4.11.3 Segmentation with Paging (MULTICS)

Unit 5: File Management **(6 hrs.)**

5.1 File:
- 5.1.1 File Naming, File Structure
- 5.1.2 File Types
- 5.1.3 File Access

5.1.4 File Attributes
5.1.5 File Operations
5.1.6 File Descriptor
5.2 Access Control Matrix
5.3 Sharing
5.4 ACL (Access Control List)
5.5 Directories and Directory Hierarchy
5.6 File System Layout
5.7 Implementing Files:
5.7.1 Contiguous Allocation
5.7.2 Linked List Allocation
5.7.3 Linked List Allocation using Table in Memory,
5.7.4 Inodes
5.8 Directory Operations
5.9 Path Names
5.10 Directory Implementation
5.11 Shared Files
5.12 Free Space Management
5.12.1 Bitmaps, Linked List

Unit 6. Device Management (6 Hrs.)

6.1 Classification of I/O Devices
6.2 Controllers
6.3 Memory Mapped I/O
6.4 DMA Operation
6.5 Interrupts
6.6 Handling I/O (Programmed I/O, Interrupt Driven I/O, I/O using DMA)
6.7 I/O Software Layers (Interrupt Handlers, Device Drivers)
6.8 Disk Structure
6.8.1 Disk Scheduling (FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK)
6.9 Disk Formatting (Cylinder Skew, Interleaving, Error Handling)
6.10 RAID

Unit 7. OS Security and Modern Operating Systems OS (2 hrs.)

7.1 Protection Mechanisms
7.2 Authentication and Access Control
7.3 Distributed Operating Systems
7.4 Mobile Operating Systems
7.5 Virtualization
7.6 Cloud-based OS Concepts
7.7 Case Studies: DOS/Unix/Linux Operating System

Practical Work:

Laboratory work will focus on implementing operating system concepts through programming and system-level tools. Students will implement CPU scheduling algorithms, solve synchronization problems using semaphores, simulate memory management and page replacement techniques, work with file handling and system calls in C/C++/java, and use Linux commands along with basic shell scripting.

SN	Title
1.	Implementation of CPU Scheduling Algorithms (FCFS, SJF, Priority, Round Robin)
2.	Simulation of Process Creation and Process Control

3.	Implementation of Inter process Communication (IPC) [Pipes, message queues]
4.	Simulation of Deadlock Detection and Avoidance
5.	Implementation of Memory Allocation Techniques
6.	Implementation of Page Replacement Algorithms (FIFO, LRU, Optimal)
7.	File creation, read, write operations in C/C++/Java
8.	Basic commands and simple shell programs

References:

1. A.S. Tanenbaum, Operating systems, Design and Implementation, Prentice Hall India.
2. H.M. Dietel, An Introduction to Operating System, Addison Wesley
3. A.S. Tanenbaum, Modern Operating System, Second Edition, Prentice Hall India.
4. W. Stallings, Operating Systems, Prentice Hall India.
5. Operating System Concepts – Abraham Silberschatz, Peter B. Galvin, Greg Gagne
6. Operating Systems Internals and Design Principles – William Stallings

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit	Hours	Marks Distribution*
1	**7**	10
2	**10**	15
3	**6**	7
4	**8**	10
5	**6**	7
6	**6**	7
7	**2**	4
Total	**45**	**60**

Note: *There may be minor deviation in marks distribution.

Computer Organization and Architecture

Course code: BCT157 **Credit Hours: 3**
Year: III **Semester: I**
Level: Bachelor **Program: Computer**

Teaching Schedule Hours / Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
Lecture	Practical	Tutorial	Theory Marks	Practical Marks	Theory Marks	Practical Marks		
3		1	60		40		100	

Course Description: This course introduces the fundamental concepts of computer organization and architecture, focusing on the internal structure and operation of modern computer systems. It explores how hardware components such as the processor, memory, input/output devices, and control units interact to execute programs efficiently. Students will study arithmetic operations, instruction sets, processor organization, memory hierarchy, and input/output mechanisms. The course also covers advanced topics such as pipelining, parallel processing, and operating system support for memory management. By the end of the course, students will understand the design principles and performance considerations of computer systems.

Course Objectives:

Upon completion of this course, students will be able to:

- Understand the basic structure and functional units of a computer system
- Analyze the architecture and operation of central processing units (CPU).
- Explain instruction sets, addressing modes, and processor organization.
- Understand control unit design and microprogramming techniques.
- Describe input/output organization and data transfer methods.

Unit 1: Introduction to Computer Organization **(8 hrs.)**

1.1 Overview of computer organization and architecture
1.2 SSI and MSI circuits
1.3 Milestones in computer organization
1.4 Classification of computer systems and families
1.5 Design considerations for performance
1.6 Evolution of processors (Pentium and PowerPC)
1.7 Future trends in computer architecture
1.8 Differences of Computer Organization and Architecture

Unit 2: Central Processing Unit. **(11hrs.)**

2.1 Structure and components of CPU
2.2 Arithmetic Logic Unit (ALU) operations
2.3 Arithmetic algorithms(Addition and subtraction, Multiplication algorithms, Division algorithms)
2.4 Instruction set architecture
2.5 Instruction formats and addressing modes
2.6 Stack and Register organization
2.7 Instruction cycle and execution
2.8 Overview of Pentium and PowerPC processors

Unit 3: Control Unit Design **(11hrs.)**

3.1 Micro-operations and control signals
3.2 Control of CPU operations, Hardwired control unit design
3.3 Microprogrammed control unit
3.4 Microinstruction sequencing and formats
3.5 Application of microprogramming
3.6 Program control concepts
3.7 Comparison of RISC and CISC architectures

Unit 4: Input/Output Organization **(12 hrs.)**

4.1 Overview of input/output systems
4.2 External devices and interfaces
4.3 I/O modules and their functions
4.4 Programmed I/O
4.5 Interrupt-driven I/O
4.6 Direct Memory Access (DMA)
4.7 I/O channels and processors
4.8 Bus architecture and communication
4.9 Data communication processors.

Unit 5: Memory Organization **(10 hrs.)**

5.1 Overview of memory systems
5.2 Memory hierarchy, Semiconductor main memory, Cache memory and cache mapping techniques
5.3 Advanced DRAM organization
5.4 Secondary storage devices(Magnetic disks, RAID storage systems, Optical storage, Magnetic tape)
5.5 Memory management hardware

Unit 6: Pipeline and Vector Processing **(8 hrs.)**

6.1 Introduction to parallel processing
6.2 Concept of pipelining
6.3 Arithmetic pipelining
6.4 Instruction pipelining
6.5 RISC pipelining techniques
6.6 Vector processing
6.7 Array processors

References:

1. W. Stalling "Computer Organization and Architecture." Pearson, 10th edition, 2021.
2. A.J. Vande Goor "Computer Organization and Architecture Design." Addison-Wesley,1st edit 1989.
3. A.S. Tanenbaun "Structured Computer Organization." Pearson Higher Education, 5th Edition, 2006.

Evaluation Scheme:

The questions will cover all the units of the course details. The evaluation scheme will be as indicated in the table below:

Unit.	**Hours**	**Marks Distribution***
1	8	10
2	11	12
3	11	10
4	12	10
5	10	10
6	**8**	**8**
Total	**60**	**60**

Note: *There may be minor deviation in marks distribution.