COURSE STRUCTURE

for

B.TECH. DEGREE

in

COMPUTER SCIENCE & DESIGN

(Applicable from the academic session 2024-2025)

DR. B.C. ROY SOCIETY
ENGINEERING
AN AUTONOMOUS INSTITUTE

Dr. B. C. Roy Engineering College

An Autonomous Institution

Approved by: All India Council for Technical Education (AICTE)

Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal (Formerly Known as -WBUT)

Jemua Road, Durgapur, West Bengal, India,713206

The first year course structure (Page 3 and Page 4) is unanimously accepted and approved in the first BoS meeting held in the Department of a) Physics, b) Chemistry, c) Mathematics, d) English, e) Electrical Engineering, f) Electronics and Communication Engineering, g) Computer Science and Engineering, h) Mechanical Engineering.

The BoS of CSD (Computer Science & Design) in its first meeting (held in the Department of CSD (Computer Science & Design) on 6th November 2024 has unanimously accepted and approved the four year course structure of CSD (Computer Science & Design).

HOD
Computer Sc. & Design
Dr. B. C. Roy Engineering College
Durgapur

Dr. B. C. Roy Engineering College, Durgapur
(An Autonomous Institution)
Syllabus for B. Tech in Computer Science & Design

Semester: V					
Sl. No.	**Course Type**	**Course Code**	**Course Title**	**Engagement Type**	**Credit**
1	PC	CSD-501	Augmented Reality, Virtual Reality & Mixed Reality	T	3
2	PC	CSD-502	Database Management Systems	T	3
3	PC	CSD-503	Operating System	T	3
4	HM	CSD-504	Introduction to Industrial Management (Humanities III)	T	3
5	PE	CSD-511	Digital Image Processing	T	3
		CSD-512	Automata Theory		
		CSD-513	GPU Computing		
6	PC	CSD-591	Augmented Reality, Virtual Reality & Mixed Reality Lab	P	2
7	PC	CSD-592	Data Base Management System Lab	P	2
8	PC	CSD-593	Operating System Lab	P	2
TOTAL CREDIT					**21**

CSD-405.1	Define / Explain the fundamental concepts / terms of Economics for Engineers (Humanities-II) and its necessity / importance.
CSD-405.2	Apply the basic principles to solve simple model problems related to Economics for Engineers (Humanities-II) in the real world.
CSD-405.3	Analyze a given Economics for Engineers (Humanities-II) problem, design and implement a solution, and compute the output.
CSD-405.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Economics for Engineers (Humanities-II) problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-405.5	Identify unsolved real world Economics for Engineers (Humanities-II) problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

Dr. B. C. Roy Engineering College, Durgapur
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Syllabus for B. Tech in Computer Science & Design

Semester-IV			
Subject/Course Name	Biology	**Subject/Course Code**	CSD-406
Contact Lecture/Week	3	**Tutorial**	Nil
Credit	3	**Maximum Marks**	100
Examination Scheme			

Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective	
1	Bring out the fundamental differences between science and engineering
2	Discuss how biological observations of 18th Century that lead to major discoveries
3	
4	
5	

Prerequisite	
1	Basic knowledge of Physics ,Chemistry and mathematics
2	
3	
4	

Unit	**Content**	**Hours/Unit**
1	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 do 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.	2

2	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, lithotropes (d) Ammonia excretion– amino telic, ureotelic, ureotelic (e) Habitata- acquatic 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. elegance, A. Thaliana, M. musculus.	3
3	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 give 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.	4
4	Biomolecules: To convey that all forms of life have 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.	4
5	Enzymes: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss	4
	at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	
6	Information Transfer: 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.	4
7	Macromolecular analysis: How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	Metabolism: 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 exergonic reactions. Concept of Keqand its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4

9	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.	3

Textbook and Reference Books

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	

Course Outcome: On completion of the course students will be able to

CSD-406.1	Define / Explain the fundamental concepts / terms of Biology and its necessity / importance.
CSD-406.2	Apply the basic principles to solve simple model problems related to Biology in the real world.
CSD-406.3	Analyze a given Biology problem, design and implement a solution, and compute the output.
CSD-406.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Biology problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-406.5	Identify unsolved real world Biology problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

Dr. B. C. Roy Engineering College, Durgapur
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Syllabus for B. Tech in Computer Science & Design

Semester-IV (PRACTICAL)			
Subject/Course Name	Computer Graphics & Animation Lab	**Subject/Course Code**	CSD-491
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective	
1	Concepts of 2D & 3D object representation
2	Implementation of various scan & clipping algorithms
3	Implementation of illumination model for rendering 3D objects
4	Implementation of a project based on learned concepts.
5	
6	

Prerequisite	
1	Programming, basic understanding of Geometry, Matrix
2	

Sl No	**Content**
1	Implementation DDA algorithm, Bresenham's line algorithm
2	Implementation Circle generation algorithm; polygon drawing; fill algorithm
3	Implementation Scaling, Rotation, Clipping & Viewing
4	Introduction to Animation in Maya, Animation related interface of Maya and animation preferences
5	Tools used for Animation in Maya, Key framing, playback and playblast
6	Introduction to Tangents, Graph editor, Dope sheet.
7	Applying animation principles to object like bouncing ball
8	Character Jump Animation,
9	Character walk cycle animation
10	Some programming beyond syllabus

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-IV (PRACTICAL)			
Subject/Course Name	Design & Analysis of Algorithms Lab	**Subject/Course Code**	CSD-492
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60
Objective			

1	Know the characteristics of various components.
Prerequisite	
1	Theoretical Knowledge about the subject ESC301
2	

Sl No	Content
1	Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2	Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
3	Find the minimum number of scalar multiplication needed for chain of matrix
4	Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
5	Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm
6	Implement 15 Puzzle Problem
7	Implement 8 Queen problem
8	Graph Coloring Problem Hamiltonian Problem
9	Knapsack Problem Job sequencing with deadlines
10	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
11	Implement Breadth First Search (BFS)
12	Implement Depth First Search (DFS)

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-IV (PRACTICAL)			
Subject/Course Name	Object Oriented Programming & Design Lab	**Subject/Course Code**	CSD-493
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective	
1	
2	

Prerequisite	
1	
2	

Sl No	**Content**
1	Assignments on class, constructor, overloading, inheritance, overriding
2	Assignments on wrapper class, arrays
3	Assignments on developing interfaces- multiple inheritance, extending interfaces
4	Assignments on creating and accessing packages
5	Assignments on multithreaded programming
6	Assignments on applet programming Note: Use Java for programming
7	Any experiment specially designed by the college (Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V			
Subject/Course Name	Augmented Reality, Virtual Reality & Mixed Reality	**Subject/Course Code**	CSD-501
Contact Lecture/Week	3	**Tutorial**	Nil
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective

1	Learn and understand the fundamental concepts of AR/VR/MR.
2	Apply the learned concepts to design moderate to large AR/VR based systems.
3	Understand rendering in AR/VR/MR and challenges
4	Be able to use geometric modelling algorithms to design virtual worlds
5	Be able to design user interactions in AR/VR

Prerequisite

1	Computer Graphics & Animation
2	
3	
4	

Unit	Content	Hours/Unit
1	Introduction, Historical perspective, Graphics pipeline, Real-time rendering in VR, Transformations, viewing and projection, Geometric modelling	10
2	Light and optics, lens systems and imaging, lens aberrations, Stereoscopy, depth and motion perception, Human perception: visual, audio, vestibular, and tactile	10
3	Introduction to Augmented Reality (AR), Mixed Reality (MR), Extended Reality (xR); Taxonomy, technology and features of augmented reality, difference between AR, VR, MR; Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR/MR environments, evaluating AR systems.	10
4	Procedural modelling and creation of large virtual worlds, Telepresence and interaction, User interfaces, social interaction and evaluation of VR systems.	10

Textbook and Reference Books	
1	Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
2	LaValle "Virtual Reality", Cambridge University Press, 2016, edition, 2009.
3	Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev, 3D User Interfaces, Addison Wesley, 2005.
4	K. S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd edition, CRC Press, 2015.
5	Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
6	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.
7	Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Meging Real and Virtual Worlds”, 2005.

Course Outcome: On completion of the course students will be able to

CSD-501.1	Define / Explain the fundamental concepts / terms of Augmented Reality, Virtual Reality & Mixed Reality and its necessity / importance.
CSD-501.2	Apply the basic principles to solve simple model problems related to Augmented Reality, Virtual Reality & Mixed Reality in the real world.
CSD-501.3	Analyze a given Augmented Reality, Virtual Reality & Mixed Reality problem, design and implement a solution, and compute the output.
CSD-501.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of an Augmented Reality, Virtual Reality & Mixed Reality problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-501.5	Identify unsolved real world Augmented Reality, Virtual Reality & Mixed Reality problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

Dr. B. C. Roy Engineering College, Durgapur
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Semester-V			
Subject/Course Name	Database Management Systems	**Subject/Course Code**	CSD-502
Contact Lecture/Week	3	**Tutorial**	1
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective

1	To understand the different issues involved in the design and implementation of a database system.
2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3	To understand and use data manipulation language to query, update, and manage a database
4	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, Designing, and implementing a DBMS.
6	To understand the different issues involved in the design and implementation of a database system.

Prerequisite

1	

Unit	Content	Hours/Unit
1	Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	9
2	Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Loss less design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	13
3	Storage strategies: Indices, B-trees, hashing.	3

4	Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi version and optimistic Concurrency Control schemes, Database recovery.	5
5	Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	3
6	Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	3

Textbook and Reference Books

1	Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2	"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.
3	Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)
4	"Fundamentals of Database Systems" , 5th Edition by R. Elmasri and S. Navathe,
5	PearsonEducation "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley
6	

Course Outcome: On completion of the course students will be able to

CSD-502.1	Define / Explain the fundamental concepts / terms of Database Management Systems and its necessity / importance.
CSD-502.2	Apply the basic principles to solve simple model problems related to Database Management Systems in the real world.
CSD-502.3	Analyze a given Database Management Systems problem, design and implement a solution, and compute the output.
CSD-502.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Database Management Systems problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-502.5	Identify unsolved real world Database Management Systems problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V			
Subject/Course Name	Operating System	**Subject/Course Code**	CSD-503
Contact Lecture/Week	3	**Tutorial**	1
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective

1	To learn the mechanisms of OS to handle processes and threads and their communication
2	To learn the mechanisms involved in memory management in contemporary OS
3	To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4	To know the components and management aspects of concurrency management
5	

Prerequisite

1	

Unit	Content	Hours/Unit
1	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of "Operating Systems, OS Services, System Calls, and Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, and Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	3
2	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non preemptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	9
3	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.	5
4	**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock detection and	5

	Recovery.	
5	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).	8
6	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary Storage Structure: Disk structure, Disk scheduling algorithms. **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	6

Textbook and Reference Books

1	Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2	Operating Systems: Internals and Design Principles, 5th Edition William Stallings, Prentice Hall of India.
3	Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
4	Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison Wesley
5	Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
6	Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates
7	
8	

Course Outcome: On completion of the course students will be able to

CSD-503.1	Define / Explain the fundamental concepts / terms of Operating System and its necessity / importance.
CSD-503.2	Apply the basic principles to solve simple model problems related to Operating System in the real world.
CSD-503.3	Analyze a given Operating System problem, design and implement a solution, and compute the output.
CSD-503.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Operating System problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-503.5	Identify unsolved real world Operating System problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

Dr. B. C. Roy Engineering College, Durgapur
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Syllabus for B. Tech in Computer Science & Design

Semester-V			
Subject/Course Name	Introduction to Industrial Management (Humanities III)	**Subject/Course Code**	CSD-504
Contact Lecture/Week	3	**Tutorial**	Nil
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60
Objective			
1			
Prerequisite			
1			

Unit	Content	Hours/Unit
1	**Introduction** System- concept, definition, types, parameters, variables and behaviour. Management – definition and functions. Organization structure: i. Definition. ii. Goals. iii. Factors considered in formulating structure. iv. Advantages and disadvantages. v. Applications. Concept, meaning and importance of division of labour, scalar & functional processes, span of control, delegation of authority, centralization and decentralization in industrial management. Organizational culture and climate –meaning, differences and factors affecting them. Moral-factors affecting moral. Relationship between morale and productivity. Job satisfaction- factors influencing job satisfaction. Important provisions of factory act and labour laws.	6
2	**Critical Path Method (CPM) and Programme EvaluationReview Technique (PERT):** 2.1 CPM & PERT-meaning, features, difference, applications. 2.2 Understand different terms used in network diagram. Draw network diagram for a real life project containing 10-15 activities, computation of LPO and EPO.(Take minimum three examples). Determination of critical path on network. Floats, its types and determination of floats. Crashing of network, updating and its applications.	8

3	**Materials Management:** Material management-definition, functions, importance, relationship with other departments. Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice.	

	Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores. Inventory control: I. Definition. ii. Objectives. iii. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. iv. ABC analysis and other modern methods of analysis. v. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.). 3.6 Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.	6
4	**Production planning and Control (PPC):** Types and examples of production. PPC: i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach for each type of production. Scheduling- meaning and need for productivity and utilisation. Gantt chart- Format and method to prepare. Critical ratio scheduling-method and numeric examples. Scheduling using Gantt Chart (for at least 57 components having 5-6 machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessary data), At least two examples. 4.7 Bottlenecking- meaning, effect and ways to reduce.	8
5	**Value Analysis (VA) and Cost Control:** 5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.	4
6	**Recent Trends in IM:** ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics- concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.	4

Textbook and Reference Books

1	L.S. Srinath– "CPM & PERT principles and Applications".
2	Buffa – "Modern Production Management".
3	N. Nair – "Materials Management".
4	O. P. Khanna – " Industrial Engineering & Management".
5	Mikes – "Value Analysis".
6	S.C. Sharma, "Engineering Management – Industrial Engineering &

7	Management", Khanna Book Publishing Company, New Delhi
8	

Course Outcome : On completion of the course students will be able to

CSD-504.1	Define / Explain the fundamental concepts / terms of Introduction to Industrial Management (Humanities III) and its necessity / importance.
CSD-504.2	Apply the basic principles to solve simple model problems related to Introduction to Industrial Management (Humanities III) in the real world.
CSD-504.3	Analyze a given Introduction to Industrial Management (Humanities III) problem, design and implement a solution, and compute the output.
CSD-504.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of an Introduction to Industrial Management (Humanities III) problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-504.5	Identify unsolved real world Introduction to Industrial Management (Humanities III) problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V			
Subject/Course Name	Digital Image Processing	**Subject/Course Code**	CSD-511
Contact Lecture/Week	3	**Tutorial**	1
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective

1	

Prerequisite

1	

Unit	Content	Hours/Unit
1	Introduction, Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	6
2	Digital Image Formation A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4
3	Mathematical Preliminaries: Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.	8
4	Image Enhancement Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8
5	Image Restoration Degradation Model, Discrete Formulation, Algebraic Approach to Restoration Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	5

6	Image Segmentation Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	5

Textbook and Reference Books

1	Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2	Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3	D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4	

Course Outcome: On completion of the course students will be able to

CSD-511.1	Define / Explain the fundamental concepts / terms of Digital Image Processing and its necessity / importance.
CSD-511.2	Apply the basic principles to solve simple model problems related to Digital Image Processing in the real world.
CSD-511.3	Analyze a given Digital Image Processing problem, design and implement a solution, and compute the output.
CSD-511.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Digital Image Processing problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-511.5	Identify unsolved real world Digital Image Processing problems, Synthesize pragmatic ideas and Create innovative solutions to such problems.

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V			
Subject/Course Name	Automata Theory	**Subject/Course Code**	CSD-512
Contact Lecture/Week	3	**Tutorial**	1
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective	
1	Be able to construct finite state machines and the equivalent regular expressions.
2	Be able to prove the equivalence of languages described by finite state machines And regular expressions
3	Be able to construct pushdown automata and the equivalent context free grammars. And be able to prove the equivalence of languages described by pushdown automata and context free grammars.
4	Be able to construct Turing machines and Post machines. Be able to prove the equivalence of languages described by Turing machines and Post machines
5	

Prerequisite	
1	Grammar and its classification (Context Free Grammar)
2	

Unit	**Content**	**Hours/Unit**
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata(DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	7
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata(PDA) and equivalence with CFG, parsetrees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.	6
4	Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	6

5	Turing machines: The basic model for Turing machines(TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, non-deterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators	6
6	Undesirability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages	6

Textbook and Reference Books

1	John E. Hopcroft, Rajeev Motwani and Jeffrey D.Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2	Harry R.Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3	Dexter C.Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4	Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5	John Martin, Introduction to Languages and the Theory of Computation, Tata McGraw Hill., PEARSON.
6	Dr. R.B.Patel, Theory of Computation, Khanna Publishing House
7	
8	

Course Outcome : On completion of the course students will be able to

CSD-512.1	Define / Explain the fundamental concepts / terms of Automata Theory and its necessity / importance.
CSD-512.2	Apply the basic principles to solve simple model problems related to Automata Theory in the real world.
CSD-512.3	Analyze a given Automata Theory problem, design and implement a solution, and compute the output.
CSD-512.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a Automata Theory problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-512.5	Identify unsolved real world Automata Theory problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V			
Subject/Course Name	GPU Computing	**Subject/Course Code**	CSD-513
Contact Lecture/Week	3	**Tutorial**	1
Credit	3	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective

1	This course will introduce parallel computing paradigms with focus on GPGPU programming to harness the massively parallel GPU architecture in solving computationally demanding tasks. The NVIDIA CUDA and industry standard OpenCL frameworks will be introduced and used with most of the labs. This is a project based course where the students will work on scientific computational problems
2	

Prerequisite

1	C Programming, Data Structures & Algorithms
2	

Unit	Content	Hours/Unit
1	**Introduction and overview**: advances in architecture and technology, need for parallel computing, examples, and challenges, **Basics on architecture and programming**: CPU/GPU architecture, multicore architecture, Flynn's taxonomy, **Single instruction, multiple threads** (SIMT) execution model.	8
2	**Parallel programming paradigms**: parallel algorithm design, analytical modelling of parallel programs, limits on achievable performance, Amdahl's law, Gustafson's law, scalability, work optimality, message passing, shared address space machines, basic communication operations, concurrency	10
3	**Introduction to CUDA C**: kernel based data parallel execution model, memory model and locality, CUDA threads, atomics, GPU utilisation. **Parallel computing using CUDA**: data transfer and CUDA streams, performance considerations, floating-point accuracy, synchronisation, communication, reduction trees, parallel prefix sum, optimisations	10
4	OpenMP, OpenACC, Multi-GPU systems, GPGPU-computing using OpenCL and OpenGL	8

Textbook and Reference Books

1	David B. Kirk, and Wen-mei W. Hwu, Programming massively parallel processors: a hands-on approach, Elsevier.

2	A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to parallel computing, 2nd edition.
3	

Course Outcome: On completion of the course students will be able to

CSD-513.1	Define / Explain the fundamental concepts / terms of GPU Computing and its necessity / importance.
CSD-513.2	Apply the basic principles to solve simple model problems related to GPU Computing in the real world.
CSD-513.3	Analyze a given GPU Computing problem, design and implement a solution, and compute the output.
CSD-513.4	Identify sub-tasks / sub-systems , Perform Diagnostic assessment of a GPU Computing problem, integrate / interconnect these sub-tasks to design an integrated working solution and Evaluate the solution.
CSD-513.5	Identify unsolved real world GPU Computing problems, Synthesize pragmatic ideas and Create innovative solutions to such problems

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V (PRACTICAL)			
Subject/Course Name	Augmented Reality, Virtual Reality & Mixed Reality Lab	**Subject/Course Code**	CSD-591
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60

Objective	
1	
2	

Prerequisite	
1	Programming, basic understanding of Geometry, Matrix
2	

Sl No	**Content**
1	Installation of Unity and Visual Studio, setting up Unity for VR development, Understanding documentation of the same.
2	Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3	Develop a scene in Unity that includes: i. a cube, plane and sphere, apply Transformations on the 3 game objects. ii. add a video and audio source
4	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a program to change the colour and material/texture of the game objects dynamically on button click
5	Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to Grab and throw the sphere using VR controller.
6	Develop a simple UI (User interface) menu with images, canvas, sprites and button. Write program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene.
7	Create an immersive environment (like - living room/ battlefield/ tennis court etc.) with only static game objects. 3D game objects can be created using Blender or use available 3D models.

8	Include animation and interaction in the immersive environment created in Assignment 7.

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V (PRACTICAL)			
Subject/Course Name	Database Management System Lab	**Subject/Course Code**	CSD-592
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60
Objective			
1			
Prerequisite			
1			

Sl No	Content
1	Creating Database • Creating a Database • Creating a Table • Specifying Relational Data Types • Specifying Constraints • Creating Indexes
2	Table and Record Handling • INSERT statement • Using SELECT and INSERT together • DELETE, UPDATE, TRUNCATE statements • DROP, ALTER statements
3	Retrieving Data from a Database • The SELECT statement • Using the WHERE clause • Using Logical Operators in the WHERE clause • Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause • Using Aggregate Functions • Combining Tables Using JOINS • Sub queries
4	Database Management • Creating Views • Creating Column Aliases • Creating Database Users • Using GRANT and REVOKE

5	Cursors in Oracle PL / SQL, Writing Oracle PL / SQL Stored Procedures
6	Any experiment specially designed by the college (Detailed instructions for Laboratory Manual to be followed for further guidance)

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**

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Semester-V (PRACTICAL)			
Subject/Course Name	Operating System Lab	**Subject/Course Code**	CSD-593
Contact Practical/Week	4	**Tutorial**	Nil
Credit	2	**Maximum Marks**	100
Examination Scheme			
Internal Exam (CIA)	40	**Final Exam (ESE)**	60
Outcome			
1			
Prerequisite			
1			

Sl No	Content
1	Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).
2	Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes
3	Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run levels, Run level scripts. Password file management, Password security, Shadow file,
4	Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users &user groups.
5	Process: starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.
6	Signal: signal handling, sending signals, signal interface, signal sets. Semaphore: programming with semaphores (use functions semctl, semget,semop, set_semvalue,
7	POSIX Threads: programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)
8	Inter-process communication: pipes (use functions pipe, popen, pclose), named pipes (FIFOs, accessing FIFO), message passing & shared memory (IPC version V).
9	Any experiment specially designed by the college (Detailed instructions for Laboratory Manual to be followed for further guidance)
10	del_semvalue, semaphore_p, semaphore_v).

Course Articulation Matrix:

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

	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**
CO2	**3**	**3**	**3**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**3**	**3**